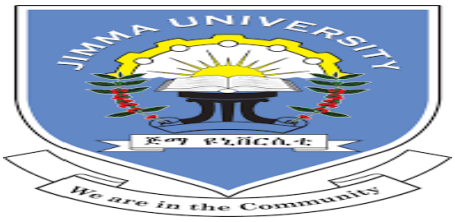

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COLLEGE OF SOCIAL SCIENCES AND HUMANITIES

DEPARTMENT OF GEOGRAPHY AND ENVIRONMENTAL STUDIES

SPATIO-TEMPORAL ANALYSIS OF URBAN SPRAWL AND ITS SOCIO-ECONOMIC IMPACTS: THE CASE OF DEBRE MARKOS TOWN: NORTH WESTERN ETHIOPIA.

BY: EMAWAYISH GEBRIE

A THESIS SUBMITTED TO SCHOOL OF GRADUATE STUDIES OF JIMMA UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN GEOGRAPHIC INFORMATION SYSTEMAND REMOTE SENSING

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PRINCIPAL ADVISOR: DR. KENATE WORKU
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DECLARATION

I declare that this thesis is my original work and has been approved under the supervision of Dr. Kenate Worku and Dr. Kefelegn Getahun, Department of Geography and Environmental Studies , Jimma University in the year 2017 while as a part of accomplishment for MSc program in Geographic information system and remote sensing . Everywhere all that sources of material utilized in this thesis have been entirely acknowledged.

Emawayish Gebrie_____ _____

Signature Date

This study is the original work of Emawayish Gebrie under my supervision

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ACRONYMS

CAS	Central Statical Agency
DEM	Digital Elevation Model
ETM+	Enhanced Thematic Mapper Puls
GPS	Global Positioning System
Ha	Hectare
LU/LC	Land use Land Cover
OLI	Operational Land Imagery
TIRS	Thermal Infrared Sensor
UNFPA	United Nation Population Fund
UN	United Nations
USGS	United state Geological Survey

ABSTRACT

Uncontrolled and unplanned urban sprawl is a common event for both developed and developing countries. Nevertheless, the level and cause varies from one country to another. Urban sprawl in developed countries is related to socio- economic development and industrialization, but the major factor contributing for rapid urban sprawl in the developing countries is attributed to rural to urban migration, natural increase and others. Debre Markos town is one of rapidly expanding town of Ethiopia over the last decade due to different factors. As a result, the objective of this study is to examine the spatial extent, pattern, rate, and socio- economic impact of urban sprawl on the community living on the outskirt of Debre Markos town with the help of GIS and RS techniques. To achieve this objective both quantitative and qualitative research approach had been used together with primary and secondary data sources. As the Analysis of the data indicate that the extent of built up land use/cover area progressively increased throughout the study period from3163.05 Ha (12.01%) to 5952.69 Ha (22.61%) in 2001 and 2017 respectively other than, farmland diminished from 11863.35Ha (45.01 %,) to 9811.53(37.27%). This LULC change is more significant impact on the socioeconomic condition and status of the study area. As the outcome proves, 84.4% of the respondent lost their land, consequently their production decrease in different amount. Generally the total expansion of the town within the sixths year duration 88.2% while, it's annual Increment *was 5.5% per year. Hence, the major corrective measures could be take on the spatial planning which can balance the land demand of urban areas and reduction of agricultural land in the fringes of Debre Markos town.*

Key words: Urban sprawl; GIS and RS

CHAPTER ONE

1. INTRODUCTION

1.1. Background of the Study

Urban sprawl can be defined as an outward expansion of a city/town and its suburbs to exurbs, to low-density and often auto dependent development on rural land (Gillham and MacLean, 2002). A phenomenon that involves the continuous growth of human population and a corresponding expansion of infrastructures that spread to absorb areas adjoining these towns/cities. Urban sprawl as a type of urban growth varies in terms of the pattern, density, and rate at which built-up land develops. This is however, dependent on the way in which development occurs (Allen & Lu, 2003). Similarly, Torrens &Alberti (2002) define Urban sprawl sometimes uncoordinated and extends along the fringes of metropolitan areas with incredible speed. Commonly, it also invades upon prime agricultural and resource land in the process. Land is often developed in a fragmented and piecemeal fashion, with much of the intervening space left vacant or in uses with little functionality. Decentralization is a trend indicative of urban sprawl and present day industrial, commercial, and residential areas are no longer necessarily a part of the urban core (Nechyba and, Walsh, 2004).

However, urbanization in case of developing countries is low; on the contemporary, the rate of urbanization is found at fastest rate. For example, around 25 percent of Africa's population lived in towns and cities in 1975. In 2000, it reached to 38 percent. The trend has been continued and the proportion is expected to increase to 47% by 2015 and forecasted to be double in 2050 (Teketel, 2015). Similarly, in case of Ethiopia level of urbanization is also low, even by African standard, where only 16% of populations live in urban area. Despite this, it has recorded a relatively high growth rate of urban population (4% annually) double that of rural areas (Dejene, 2011).

The increasing of urban sprawls in most cities in developing countries continue to attract attention of national and international agencies and researcher but the efforts had not achieved much result at checking the sprawl (Donk, 2006). African cities in particular produce miseries that are often difficult to comprehend. Most of the continent's cities including those in Ethiopia are faced with the problem of rapidly deteriorating physical and living environment (Olurin, 2003). As far as the issue of urban sprawl concerned, one of the prerequisites for understanding urban sprawl is successful land use change detection (Jain, 2009). Therefore, as recommendation of these authors Alexakis etal.(2012) monitoring urban sprawl is a vital part of assessing current trends with a view of improving urban quality of life in the future as sprawl affects man and the environment adversely. As Herold etal (2002) Stated; to tackle this problem GIS and remote sensing can provides useful information for the monitoring of urban land use change. GIS gives the opportunity to detect land use changes, visualize them, monitor them, and even forecast them. Remote sensing gives the ability to exquisite data via the space or air borne sensors, resulting in multispectral, multi-resolution, and multi temporal data, which is used for the creation of land use maps. Urban sprawl mapping and monitoring is one of the equipped applications of satellite remote sensing data, irrespective of its spatial and spectral resolution of the satellite-borne sensors.

Thus various studies had been conducted for quantifying urban sprawl in developed countries as well as, developing countries. However, all these studies have come up with different methodologies in quantifying sprawl. But the common approach is to consider the population density over the spatial and temporal changes taking place. The relation of population growth and urban sprawl is that the population growth is a key driver of urban sprawl. Modeling of the sprawl can be done using both spatial and statistical parameters, i.e., land use, built-up areas, and population (Sudhira, 2003).In this study, the integrated technologies of remote sensing and the geographic information system (GIS) used to identify and analyze the pattern of urban sprawl and its impacts on the peripheral part of Debre Markos town.

1.2. Statement of the Problem

Urban sprawl is the common problem for developed and developing countries. Nevertheless, the severity of the problem is different at both countries. Ethiopia like many developing countries had faces for unplanned urban expansion and residential houses sprawl in many of its towns and cities. This growth extends not just inwards but outwards implying that satellite towns surrounding the city are being affected posing a threat to the limited available resources in the city resulting to high cost of living. To this end, Sudhira et al. (2004) state that understanding the patterns of urban sprawl can help with natural resource planning, natural resource utilization, and the provision of infrastructure facilities. The most pressing problem of sprawl is the substantial loss of fertile agricultural land around many towns because of urban sprawl. As Cervero (2000) study Social and health impacts of sprawl leads to an erosion of functioning urban cores. This has not only social and infrastructural consequences, but also impacts on improvement capacity of regional economies.

For instance, over the last decades Debre Markos has significantly expanded due to different developmental activities and migration of people from rural sites, as well as various changes have occurred in the town. This expansion to its rural outskirts, overtaking the wide, highly productive agricultural Lands mostly used for cereal crops production and even this problem encounter the internal development of the town. Diverse way exists for identifying urban sprawl such as recording the location and number of building permits or simple visual assessments. Nevertheless, these data are often difficult to incorporate for instance, compiling paper building permits into useful statistics, are frequently subjective and may not accurately capture temporal patterns of urban growth and change in peri-urban rural environment. The use of remotely sensed data to analyze urban sprawl and rural hinterlands distribution allows land use planners to perform large-scale temporal analyzes with minimal investment of time and money. However, as yet, no study had been conducted in Debre Markos town based on this issue and also there are no regularly efficient maps to specify those changes. Generally this thing create interesting to selected Debre Markos town as a study area in current years. As a result, there is need to conduct such a research in order to analyze the rate and

pattern of urban sprawl and its impact on the peripheral farming communities through the integration of remote sensing and Geographic information system technology .

1.3. Objectives of the Study

1.3.1. General Objective

The general objective of this study was to analyze spatio-temporal variation of urban sprawl of Debre Markos town and, its socio-economic impacts using GIS and RS techniques.

1.3.2. Specific Objectives

- To investigate and quantify the extent of urban sprawl of the study area between 2001 and 2017.
- To assess the rate and pattern of urban sprawl in the study area.
- To identify the socio-economic impacts of Urban sprawl on the surrounding farming communities.

1.4. Research Questions

In order to achieve the stated objectives of the study the following research questions were formulated:

- What extent is the urban sprawl in Debre Markos town between study periods?
- What is the rate and pattern of urban sprawl in Debre Markos Town between 2001 and 2017?
- What are the major Socio-economic impacts of urban sprawl on the surrounding farming communities?

1.5. Significance of the Study

The study finding of this study may have enormous contributions for any stakeholders who needs information about urban planning of fast changing regions, to make sustainable and smart decisions over and above, this study result may have some

contribution to understanding the impact of urban sprawl on land use land cover change and also helps for decision makers, urban planners, and concerned body to design the appropriate strategies and policy to reduce the negative effects of urban sprawl on the peripheral part of the city/ town as well as demonstrate the application of geospatial techniques in urban study. Furthermore, it serves as a benchmark for researchers who have interest to conduct further studies on this and related issue.

1.6. Scope of the Study

The study had been carried out on urban sprawl and its impact on Debre Markos town. For the past decades, this town was experiencing horizontal expanding over the peripheral areas. Following with the towns' expansion, land use arrangements are also changed from different land use pattern to urban built-up and other purposes. Therefore, this study concentrates to determine the extent, rate, impact and pattern of urban sprawl in the study area. As far as, the delimitation of the topic concerns, the study had went to produce Urban sprawl map and to investigate its Socio Economic impact on the surrounding area by using the integrated technology of remote sensing and geographic information system and socio-economic data.

1.7. Limitation of the Study

This study had faced some limitations, among these, lack of access to high resolution satellite imageries as well as appropriate financial support to purchase the required satellite images were the major one. To overcome these problems the researcher used the medium resolution and freely available satellite imageries. Further, most of the participants were illiterate in the study area this created miscommunications with the writer. Thus to alleviate this problem the researcher had to transform the questions into the Amharic. Likewise, as many studies have pointed out that, respondents are unwilling to provide accurate information on variables because they related these variables in different case and direction. However, this study was not free from these limitations. Nevertheless, to alleviate this problem as much as possible the researcher tried to induce respondents about the objectives of the researcher and certainty of respondent's confidentiality of information.

1.8. Organization of the thesis

This thesis comprises five chapters. The first chapter deals with the problem and its approach in which background of the study, statement of the problem, objectives, significances, and scope of the study. The second chapter presented with the review of related literature; the third chapter is methodology of the study, the fourth chapter deals with data analysis and interpretation and the last chapter deals with summary, conclusion and recommendation.

CHAPTER TWO

2. LITERATURE REVIEW

2.1. Concepts of Urban Sprawl, Remote Sensing and GIS

Terminologically, ‟ Urban Sprawl'' is just over spreading out of a city and its suburbs towards the periphery of an urban area. While in reality, a complex phenomenon; means different things in different areas and conditions. Formerly, the term has been used to express excessive consumption of space in an uncontrolled, disorderly manner that leading to poor distribution and loss of open spaces, over transportation demand, and social segregation (Black, 1996). As Lata et al. (2001) it is defined as the scattering of new development on isolated tracts, separated from other areas by vacant land. Ewing (1997) also suggested that Urban sprawl is characterized by leapfrog land use patterns, strip commercial development along highways, and very low-density single-use developments, all of which occur over a relatively short period of time. Urban Sprawl is a pattern of land use in an urbanized area which has low levels of combination thus elements; density, continuity, concentration, compactness, centrality, nuclearity, diversity and proximity (Galster*et al*., 2001). Geographic Information System is software that use of geo referenced data to visualize, question, analyze, and interpret cases in order to understand relationships, patterns, and trends on the land use \land cover change (Mbuta, 2013).

Remote sensing refers to the science or art of acquiring information of an object or phenomena in the earth's surface without any physical contact with it. And this can be done though sensing and recording of either, reflected or emitted energy and the information being processed, analyzed and applied to a given problem (Campbell, 2002). Herold et al (2005) what's more, stated that even though Remote Sensing is recent technology, one of the advantages of remote sensing in any detection study is its ability to provide spatially consistent data sets covering large areas with both high detail and high temporal frequency, including historical time series. In the past time spatial data can be

obtain through the means of conventional surveying cartographic technique. However, unfortunately, the conventional surveying and mapping techniques were expensive and time consuming for the estimation of urban sprawl and such information is not available for most of the urban centers, especially in developing countries. As a result, increased research interest is being directed to the mapping and monitoring of urban sprawl/growth using GIS and remote sensing techniques (Goetz, 2013).

2.2. Urban sprawl and Land Use/Land Cover Change Analysis

Most of the time urban sprawl is difficult to estimate because it can occur gradually over time. Wilson et al. (2003) argue that without a universal definition of sprawl it is extremely difficult to model. Not all urban growth is considered sprawl because what is sprawl to some may not be to others. Some sources have been defined in terms of associated causes: urban sprawl is generally believed to result from poorly planned, large-scale new residential, commercial and industrial developments in areas not previously used for urban purposes (Zhang, 2001). However, there is one dominant theme in the recognition of urban sprawl: a spatial-temporal signature unique to the phenomenon. Urban sprawl is characterized by leapfrog land use patterns, strip commercial development along highways, and very low-density single-use developments, all of which occur in relatively over a short period of time (Ewing, 1997).

Change detection refers to the study of identifying changes of the state of an object (phenomenon) in time. Different steps are used to identify changes, by making use of different multi temporal data sets of an area, which can be done with remotely sensed data (which is the most of the time the source for the creation of land use maps). Change detection is successfully applied in the following applications; urban sprawl mapping land use change analysis, monitoring shifting cultivation, assessment of deforestation, study of changes in vegetation phonology, seasonal changes in pasture production, damage assessment, and other environmental changes (Singh, 1989, p. 989). The process of change detection also provides more insight into the underlying land use changes. The most common method for land use change detection is post classification comparison (Araya, 2009, p.22-24, Singh and 1989, p.996). There are also other change detection

methods like; image differencing, image rationing, image regression, and vegetation index differencing, which are categorized into two main change detection methods; pre-classification and post classification methods (Mubea et al., 2010, p. 127).

However, Araya (2009) and Singh (1989) provide the most commonly used method is post classification comparison, more information on the other methods. Post classification comparison refers to the comparison of independently classified images (of course of the same source, otherwise classification definition problems might arise). Of course, the accurateness of the change map is dependent on the precision of the classification of the land use map, the resolution of the land use map and other error propagations (Mubea et al., 2010, p. 127).

2.3. The role of GIS and RS Techniques in Urban Sprawl Study

One of the most important paradigms in Geography and related disciplines that manage or use of spatial data, associated with methodological changes is the advancement in satellite Remote Sensing and Computer aided Geographical Information System and the availability of satellite imageries. Remote sensing technology has been the subject of research in a variety of contexts and situations and has been successfully emerged as the only, complementary or corroborative source of data for many applications (Batty, 2000).

Remote Sensing technologies have a vital role in acquiring detailed information accurately that can be use full for management and planning of urban regions. However, the determination of land use data with high geometric and thematic accuracy is generally limited by the accessibility of adequate Remote Sensing data in terms of spatial and temporal resolution and digital image analysis techniques (Herold, 2002). Hence various remote Sensing techniques have a powerful tool for studying urban area and related activities like land use/cover changes, urban growth modeling, urban sprawl etc. Image classification is one of the important application aspects for Remote Sensing technique among the other by using computer with specific software, like Erdas (Li, 2009).

For decades, the visual interpretation of aerial photography of urban area has been based on the hierarchical relationships of basic image elements. The spatial arrangement and

configuration of the basic elements (tone and color) combine to give higher order interpretation features of quarters complexity such as size, shape and texture or pattern and association, that are significant and characteristics for urban areas and urban land use visual interpretation and classification (Bowden, 1975). Much of the expert knowledge of the human image interpretations was lost in the transition from air photo interpretation to digital analysis of satellite imagery. The enormous vitality of Remote Sensing is that it can provide spatially consistent data sets that cover large areas with both high detail and high temporal frequency, including historical time series. Mapping of urban areas has been accomplished at different spatial scales e.g. with different spatial resolutions, varying coverage or extent of mapping area and varying definitions of thematic mapping objects (Herold, etal. 2005).

Global and regional scale studies are often focused on mapping just the extent of urban areas (Schneider et al., 2001). One of the basic difficulties of mapping urban area from remotely sensed data is that of indistinct demarcation between urban and rural areas on the edge of the city. Remote Sensing provides an additional information that more closely respects the actual physical extent of a city extent still remains problematic and individual studies must determine this own rules for differentiating urban from rural land (Clarke and, Gaydos, 1998). There for remote sensing technique has a great contribution for urban study. Therefore, data come from satellite images on land-use/land-cover change are of great importance to planners in monitoring the consequences of changes that could occur on a given place. Although urban monitoring and modeling applications usually rely on widespread historic archives of land-use/land-cover maps, most remote sensing research in urban environments tends to focus on high resolution satellite imagery. High resolution images such as Ikonos include a large variety of regions occurring in complex configurations that are challenging to interpret with low resolution image.

2.4. Theoretical Literature Review

According to Clark (1996) discusses, there are two major theories explaining urban expansion. **I)** The primacy of economic benefits **ii**) Role of urban social production in

urban area, as of economic benefits primacy theory, there are the agglomeration of different economic activities and economies of scale resulting from it. Hence, to improve economic benefits of production, people move to urban area from rural areas and/or even one urban areas to another, rural- urban migration or urban-urban migration. This increment on urban population stimulates urban lately to grow towards peripheral areas. The urban social production theory on the other hand argues that, urban is more congested and congregate, and even much denser than rural and peripheral regions. Still, the area has higher pulling power of attracting people in to it. This pulling force of urban areas is however, the result of continuous social interaction and internet work which resulted finally in to the congregation of large people at smaller unit of land than rural regions. As sited by Muluken (2009: 13) in history of urban evolution, cites began to exist for many reasons such as defense, trades, political or religious centers. What so ever the reason, economic force are likely to reinforce the original impulse. With industrialization, which induced more intensive use of existing buildings, change in the pattern of uses and out ward expansion in the peripheral areas is predictable (Firew, 2010).

2.5. Empirical Literature Review

2.5.1. Trend of Urbanization and Urban Sprawl

2.5.1.1. Global Trend of Urbanization and Urban Sprawl

The issue of urbanization/urban sprawl began in Europe at the time of the industrial Revolution and gradually spread to other parts of the world. Until mid 20th century, urbanization was seen as a process that was largely restricted to the core regions of mercantilist, industrial capitalist and monopoly capitalist systems, where it produced high levels of urban development across large parts of Europe and North America (David, 1996). The pace and extent of urbanization varies considerably among countries and regions (Gibert and Gugler, 1985). Accordingly, Africa and Asia were almost wholly rural in 1950s (David, 1996). Nevertheless, significant urban development began to affect some parts of the Middle East and Africa between1950s and 1970s.

The urbanization process in developed countries was gradual and related to social and economic conditions improvement, while, urbanization in the third World Countries is a sudden explosion caused mainly by rural-urban migration and without significant development of industrialization (Adem, 2010). The level of urbanization varies significantly even among the region of developing world. In 1990 Latin America was 73 percent urbanized compared to the developed world and is projected to be 85 percent urban in 2025. Whereas in Asia and Africa much smaller proportion of the population live in urban areas but these regions are urbanizing faster than Latin America (UN, 1990). In addition, the rapid natural population growth in third World Countries, particularly since World War II is unique in human history. The rate of urban growth and the absolute increase in the size of urban population had no parallel. However, the rate of urbanization in developing countries was similar between 1950s and 1970s to the rate that characterized the urban transition in Europe 75 years earlier (Gugler, 1988). The proportion as well as the total number of people who live in towns and cities is increasing at the global scale. Each year some 312 million or more people are added to urban areas.

In 1950s, around 25 percent of the world‘s population lived in towns and cities, and it was estimated to be about 75 percent by 2010 (David, 1996). From 1950s to 1970s the cities of the developing world absorbed over 35.3 percent of global population increase and about 53.4 percent between 1975 and 2000. At the end of 20th century, the urban population of developing countries was close to 41 percent of the total population, compared to less than 16 percent in 1950. In general, the urban population in developing countries increased almost eight folds, compared to an increase of 2.4 percent in the developed countries (George, 1988). As population increases, urban sprawl on a global scale is becoming more apparent than ever. Increases in population often lead to increases in development, which has a direct influence on agricultural land conversion. Moeser (2000) states; that urban growth is inevitable over the next two decades and that most of this growth will take place in less developed countries.

2.5.1.2. Trends of Urbanization and Urban Sprawl in Ethiopia

According to CSA (2008) report, Ethiopia is the third most populous country in the whole of Africa exceeded only by Nigeria and Egypt. About 84 percent of the total population in the country was found in rural areas, while the remaining 16 percent lived in urban areas. As compared to other African countries, urban population growth in Ethiopia is forecasted to be 6% with a number of serious social problems, which is much higher figure. The country also has least urbanized areas as compared to other third world nations. More than 80 percent, the country economy almost entirely depends on agriculture, although production and food provision is low due to bad weather conditions and lack of effective technology.

In Ethiopia, the process of urbanization has wide range of regional differentials or polarization. Rural to urban migration is the major challenge. For this, tribal wars and conflicts are common cases that push people from their villages to urban like most developing countries. Now, Slum is emerging in different parts of cities, but it is high particularly in capital and medium cities. Over demand for housing purpose is not considered with the need to prevent horizontal expansion to saving over land scrambling. Formal and informal settlements lead to horizontal development from the central cities in all directions. Land is inadequately and ineffectively utilized; new developments are planned on virgin land usually leapfrogging from cores. Generally, as (Haregewoin, 2005) argument, sprawl and misuse of urban land in Ethiopia is occurred due to over population pressure (both from natural births and migration), poor land policies, lease system and planning and regional imbalance. Therefore, applicable measurement is needed to provide for immediate needs of the population while trying for solutions to overcome mismanagement of land and further horizontal expansion with minimum financial expenditure.

2.5.2. Causes of urban Sprawl

In most developing countries of the world, population growth is considered as the main causes of urban sprawl. From an economist point of view, as population raises in an urban area it becomes more difficult to locate the same percentage of residential houses

and business activity if the urban boundaries remain fixed. In addition, higher income residents generally demand larger quantities of housing and the inexpensive land to build it on is more likely on the fringe of developed urban areas (Ewing, 1997). Additional reason of urban sprawl to occur as stated by UN-Habitat (2010) report was because authorities pay little attention to slums, land, services and transport. Moreover, they lack the ability to predict urban growth and, as a result, fail to provide land for the urbanizing poor. In addition, the urban poor are denied land rights which are one of the main factors driving people to the periphery of towns, associated with urban sprawl in developing countries.

In developing country the causes of urbanization are twofold: people migrate from rural areas to cities for employment opportunities, and fertility rates of the people already living there are high. There is a critical key difference between urban sprawl development in developed and developing countries in developed nations, peoples did not have preferred to reside in the cities and they choose to move out. However, in developing countries, people move out because there is not enough space for them to live in the city (Haregewoin, 2005). The movement of the people from the city center to the sub urban part due to lack of space results spread of development without sufficient infrastructural provision. This pattern of development crates problems such as the wastage of agricultural land become a burden for service provision.

2.5.3. Indicators of Urban Sprawl

Urban sprawl processes most of the time take one or more pattern: fragmentation, leapfrogging, discontinuous development etc. For urban sprawl, a patent and single distinction requires justified rules in weighting up several components and indicators. So as to scientifically measure and identify the extent of urban sprawl in a given area, many scholars and research institutions presented their “Sprawl index”, which could exactly shows the sprawling situation of a whole city or region based on the situation (Jiang Fang et al. 2007).

Built up area was taken as an important indicator of measuring it, common in most urban sprawl studies (H. S.Sudhira, T. et al. 2004). According to the research result of

Siedentop and, Fina (2008) there are three recognized indicators that could be used to measure urban sprawl, including density, pattern and surface indicators, which cover the different dimensions of sprawl corresponding with environmental, social and economic impacts of urban land use change. In his finding, surface indicators are focused on the quantitative composition of land use regarding features of land cover; Pattern indicators depict distributional aspects of urban entities; Sprawl-type developments contribute to declining urban densities so that density is a very important indicator. As understand form the above fact there is different types of urban sprawl indicators but for this study built-up (surface) area as a potential and fairly accurate parameter to measure urban sprawl.

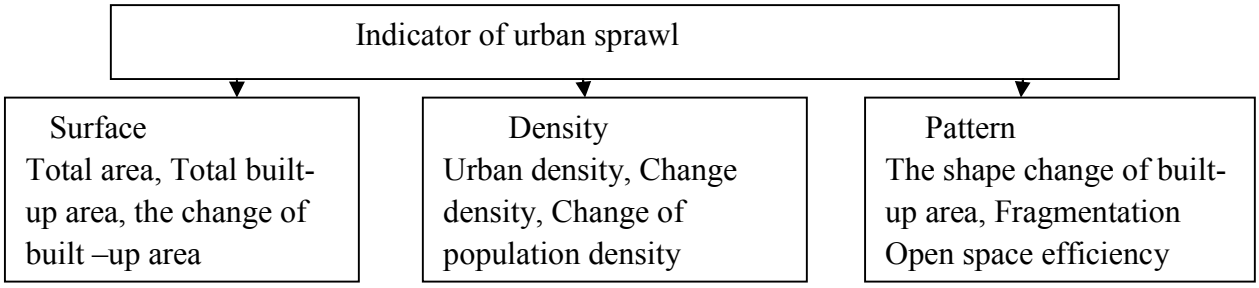

Figure2.2: Indicator of urban sprawl

Source: Li Feng, 2009

Galster et al. (2001) also try to mentioned and describe urban sprawl indicators in the following ways.

Density: is a widely used indicator of sprawl whereby different types of density can be described

Continuity: is the degree to which the unused land has been built densely in an unbroken fashion. Sprawl can be continuous or discontinuous in other places.

Concentration: describes the degree to which development is located disproportionately rather than spread evenly.

Clustering: sprawl is frequently clustered what means that it only occupies a small portion of the respective land area.

Centrality: the loss of centrality is one of the most serious concerns about sprawl.

Nuclearity: describes the extent to which an urban area is characterized by a mononuclear pattern of development.

2.5.4. Measuring Urban Sprawl

Urban sprawl is often thorny to estimate because it can occur slowly over time. According to Wilson et al (2003) argues that without a universal definition of sprawl it is extremely difficult to model. Not all urban growth is considered sprawl because what is sprawl to some may not be to others. "Creating an urban growth model instead of an urban sprawl model allows us to quantify the amount of land that has changed to urban uses, and lets the user decide what he or she considers being urban sprawl". Many studies indicate that the pattern, density, and rate of new urban growth that creates the appearance of sprawl or ways that are used to measure the extent of urban sprawl. These methods of urban measurement do not give accurate information. To avoid this gap the researcher uses RS techniques, Geographic Information Systems (GIS), community surveying, key-informant interviews with planners and developers, and planning documents to measure the extent of urban sprawl and its impact.

2.5.5. Patten of Urban Sprawl

The urban sprawl pattern identification is a visual interpretation of where the occurring growth of the urban area is located. It is helpful to identify the shape of the pattern, its future directions, and which environments are threatened by the urban sprawl. The spatial pattern becomes visible by systematically mapping the growth in time. The pattern and the configuration of the urban sprawl can be further described by making use of landscape metrics. Visualizing urban growth is not the only way to foster pattern identification. It is also very helpful to classify the growth in time. What kind of growth is occurring is the new created urban area a result from the expansion of the existing urban area (Eryilmaz et al., 2008). Thus to identify the spatial pattern of urban sprawl in this study the researchers had used systematically mapping of urban sprawl with the help

of GIS and RS tools and visual interpretation has been applied to identify the pattern of urban sprawl.

However, according to Galster et al. (2001) classified urban sprawl into the following five types, which are classified in terms of degree of compactness, dispersion or 'scatter.(1) Compact contiguous development: sprawl forms gradually around the urban area, not creating patches, and mainly has a high density. (2) Strip or linear development: the urban expansion along infrastructural works or rivers, the expansion is continuous but scattered, leaving agricultural and natural land open. (3) Poly-nucleated nodal development: several smaller towns are agglomerated; the sprawl is discontinuous, much lower density than the traditional settlement, physically separated from the urban city of which it sprawled. (4) The scattered sprawl development: uncoordinated discontinuous development away from the historical central core, creating open and vacant land between new built-up areas.5) Leapfrogging development: is the development that leapfrogs over existing barriers.

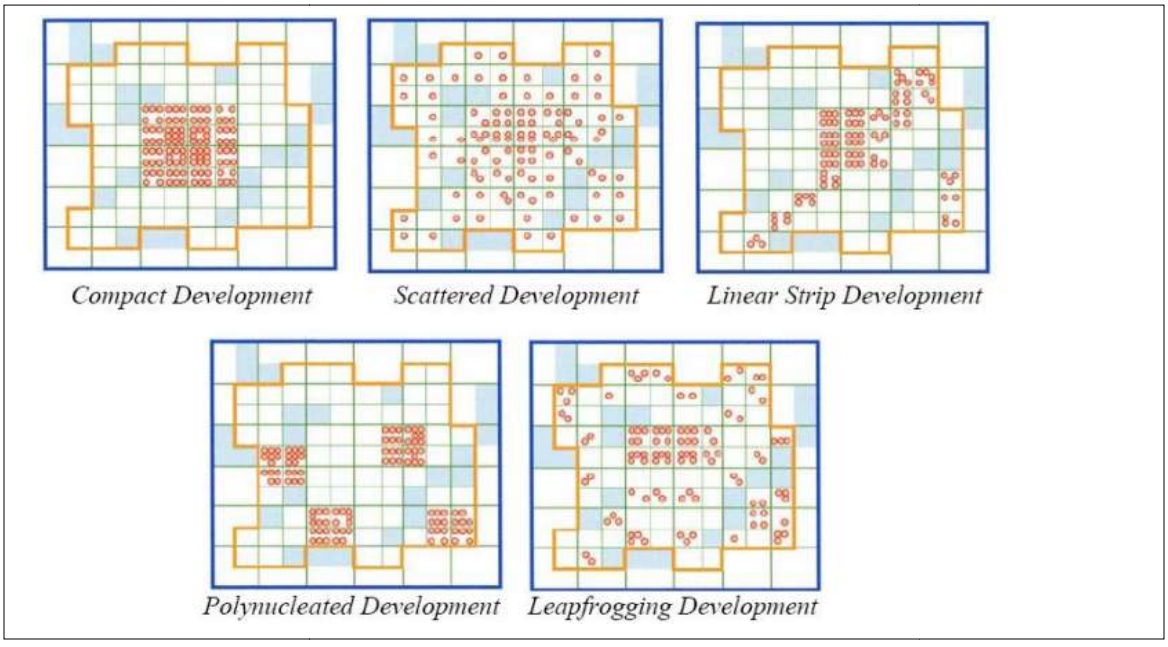

Figure 2.3: Patterns of Urban Sprawl

Source: Dennis Weijers, 2012

2.5.6. Urban Sprawl and Associated Impacts

In developing countries people are migrating from rural areas to urban centers and from the centre the poor also move to the periphery for urban renewal or squatting. These areas need provision of infrastructure like road, power line, water pipes and drainage line. This requires high development cost that draws on the financial capacity of the municipal government. In many cases the municipality cannot afford to provide and people remain deficient of basic means of life. Because of this most of the residents are exposed relatively to high cost of living (World Bank, 2004). This cause limited work opportunity in the area. The problem is more intense to the dislocated and dispossessed farming community since they lose their means of livelihood.

Urban expansion results in displacement, dislocation and segregation of urban neighbors in general and neighboring farmers in particular that result in social makeup disorder. People in the extended urban areas "live still partly rural and where many of the residents live in the country side but are not socially and economically of it". They usually do not participate in the planning and design of resettlement and dislocation options as well as the distribution of associated costs or benefits. Since social infrastructure is concentrated in the centre people in the extended area rely on proximity to facilities. This involves long commute or travel for work, market and other basic social needs. Specifically, low-income households will continue to live in such sever social constraints in the periphery (Carter, 1995).

CHAPTER THREE

3. METHODOLOGYOF THE STUDY

3.1. Description of the Study Area

3.1.1. The Physical Setting of the Study Area

3.1.1.1 .Location

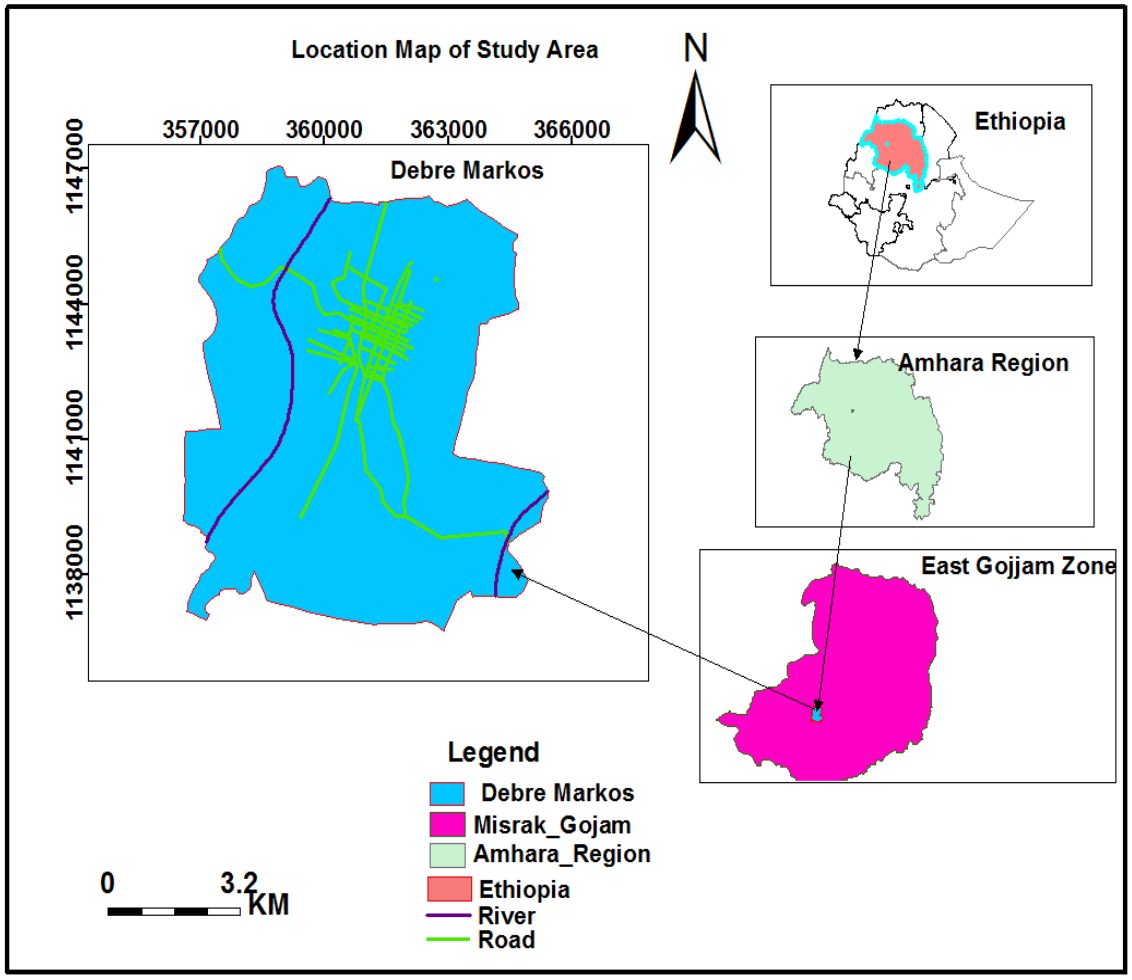

Figure3.1: Location Map of Study Area

Source: Ethio-Shapfile, 2017

Debre Markos has seven kebeles which is one of the oldest historical medium sized towns of Ethiopia. It served as the capital city of Misrak Gojjam administrative zone until 1995. Debre Markos is located at the distance of 300Kms in the north west of the capital city of the FDRE of Ethiopia, Addis Ababa and 265Kms from the capital of Amhara National Regional State of Bahir Dar. It is located latitude and longitude of10˚20ˈN, 37˚43ˊE and an average elevation of 2,446 meter above sea level and it has moderate temperature (The Enlightenment, 2009).

3.1.1.2. Historical Foundation of the Town

Before one and half centuries ago, in 1853, Dejazmach Tedla Gualu governor of Gojjam found Menkorer, presently known by Debre Markos: He ruled Menkorer for nearly three decades (1853-1881). In 1881 the first Church-Saint Markos was built in Menkorer. Just a year after and onwards, the town got a name Debre Markos after the church of St Markos. The former Menkorer, the present Debre Markos, became the historical, administration and commerce center of Gojjam for long period of time. The city did not show any significant development till 1997 EC. At present the city has shown some progress (Adem, 2014).

3.1.1.3. Topography

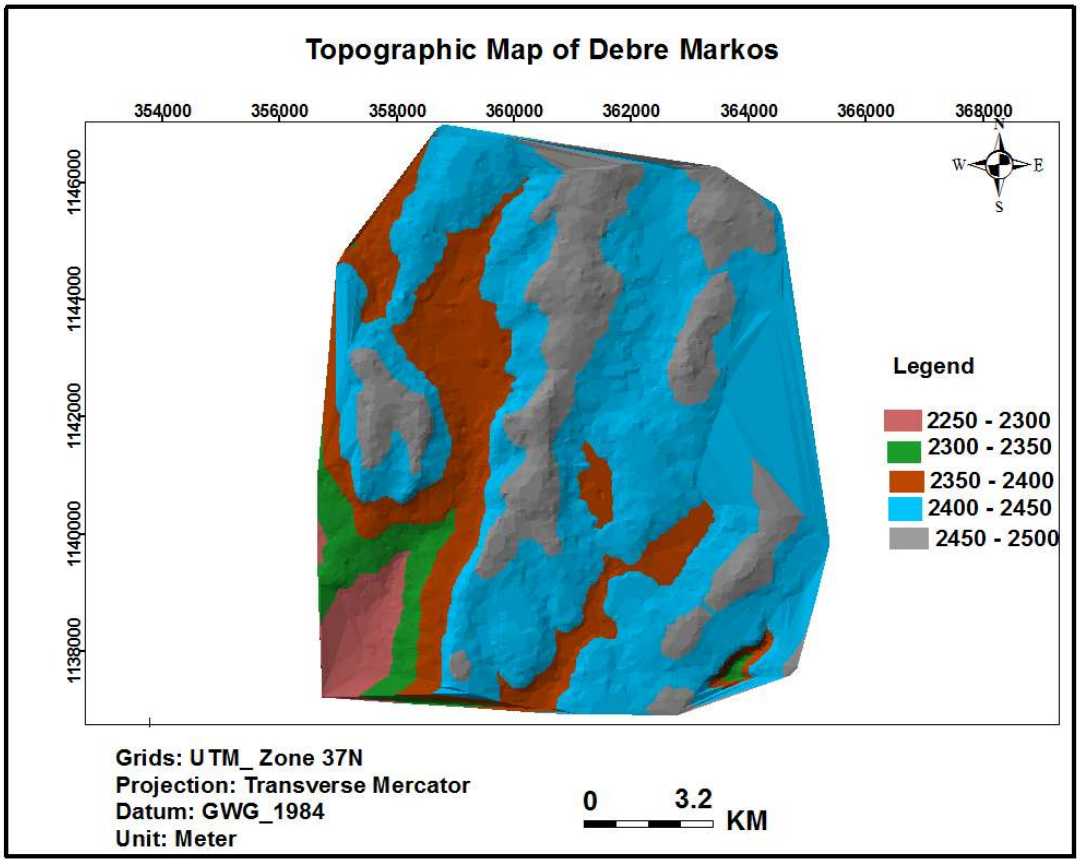

Figure3.2: Topographic map of Study Area

Source: SRTM30m

Debre Markos town is one of the high land areas of the country. Thus the area is dividing by three swampy areas mainly flood plains and to some extent ridges, escarpments, and streams related with gullies. Based on these physical land escape setting the town house construction industry office classified the slope into three major categories. Land with 0-2.5 percent slope: this area refers to the swampy areas which cover 20% of the total urban land. Land with 2.6-20 percent slope: this slope class constitutes 75% of the area of the town which is suitable for settlement and other functions. Land with > 20%: this refers to the land characterized by gullies, ridges and escarpments which account 5% of the land resources (Debre Markos house construction office, 2017).The areal coverage of the town is 6,160ha and has nearly oval shape (Esubalew, 2006).

3.1.1.4. Climate

The climate condition, most of the time is, 'Woina dega'. The town enjoys a tropical climate with a mean annual rainfall of 1308 mm, temperature 16^{o}c, while the maximum and minimum recorded temperature being (24^{o}c and 4^{o}c respectively). The main rainy season is from June to October and most of the annual rainfall is precipitating in these four months' time. The second annual rainfall precipitates from March to May in three months' time. The remaining months are relatively dry. The maximum monthly temperature is recorded in February to May which is more than 25 ˚c and the lowest maximum monthly average temperature is recorded June to October which is 17˚c to21˚c (Adem, 2014).

Table3.1: Average Temperature and Rainfall Distribution of Debre Markos Town (1987- 2016)

Year(1987- 2016)	Average Temp (^{o}c)	Average Rain fall (Mm)
Jan	16.6	12.2
Feb	18.4	14.04
Mar	18.1	49.92
April	18.84	66.4
May	18.2	109.66
June	18.2	168.01
July	16.6	280.83
Aug	15.6	316.78
Sep	15.98	232.38
Oct	16.79	80.41
Nov	16.5	25.91
Dec	16	18.72

Source: Bihar Dar Meteorology Station, 2017

3.1.1.5. Geomorphology

Debre Markos town is located on a plateau of northwestern highlands of Ethiopia. The plateau where the town is built is surrounded by Abay River's deep gorge on the eastern and southern sides and western lowlands on the western side. The general elevation of the region is over 2,000 meter above sea level and Choke volcanic mountain that rises to over, 4,000 m.a.s.l. is situated on the plateau. The surroundings of Debre Marko's town are undulating hills and valleys but between the hills there are a wide marshy plane areas. Some of these plains are over 10 km. across (Adem, 2014).

3.1.2. Demographic and Socio-economic Profile of the Study Area

3.1.2.1. Demography

According to Central Statistics Agency (2007), the population of Debre Markos town was 62,497. Out of this 29,921 (47.87%) were males and 32,576 (52.1%) were females; 16,325 (26.14%) were within the age group of 0-15years, 42,185 (67.49%) 16-60 years, and 3,987 (6.37%) 61 years and above. As stated by Central Statistic Agency (2013), the population projection figure of the town had been estimated 38291 male and 41689 female inhabitants which is a total of 79980 populations. Area of the town is expected to be 1214.9 sq. Km and 65.82 km/square density. Debre Markos is predominantly settled by the Amhara people with ethnic composition of 97.12% Amhara, 1.29% Tigre, 0.67% Oromo, 0.56% Agew and 0.36% others. Religiously, 97.25% constitute Orthodox Christian, 1.88% Muslim, 0.81% Protestant and 0.6% others (Debre Markos City administration, 2005).

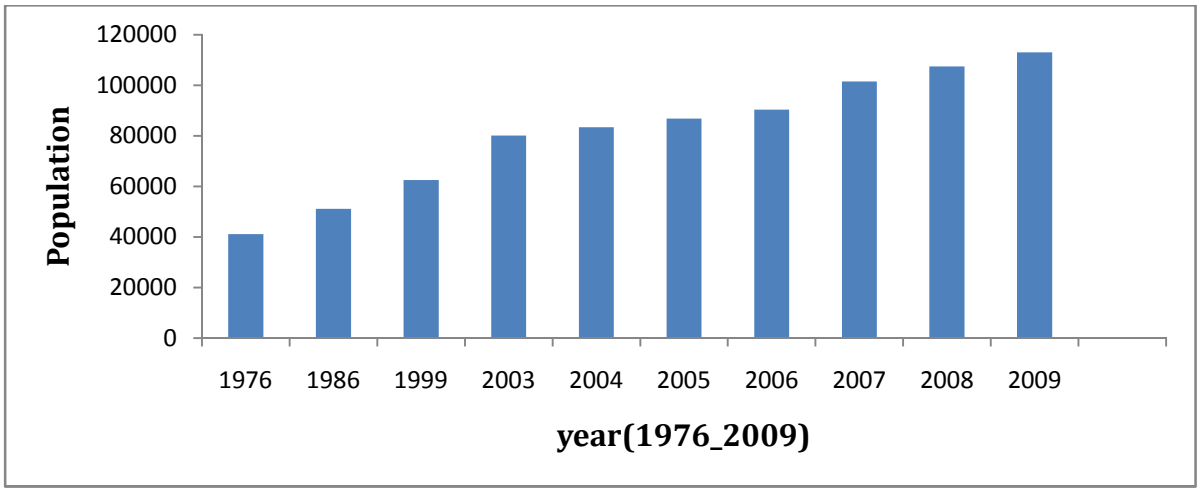

Figure3.3: Population Growth Trend of Study Area (1976-2009 E.C)

Source: Debre Markos Town Administration, 2017

3.1.2.2. Socio-economic Profile

The economic activity and social infrastructure of the town is low and the overall life standard of the inhabitants is not in good condition (Esubalew, 2006). This is due to lack of diversified opportunities such as, absence of commercial crops in the nearby areas, homogenous culture, same language, religion, lack of commerce, and entrepreneurship. However, Livestock keeping is widely practiced in the town of Debre Markos. There are both small and medium scale agricultural practices in the town. The small scale farming are done by small holder urban farmers for subsistence living. These activities include livestock keepers in the town usually let their animals roar freely, particularly during the winter season eating grass, crop residues in the field or whatever they can find. Cattle fattening and milk production were the most common livestock, though sheep, pig, poultry were fairly numerous in the towns under study. There were also a small number of horses and mules used for cart traction purpose in the town. A small variety of vegetables were identified in Debre Markos Town. These vegetables are mainly found in the stream bank and backyard, and other similar sites. There are also medium capital intensive agricultural practices in the town; like dairy production, cattle fattening, and poultry farm and other agricultural investments. Even though, there are legal agricultural

investments there in the study area no large scale agricultural practices are promoted in the town. The area is suitable for agricultural investments (Maru, 2014).

3.2. Research Design

A mixed research approach was applied in the course of doing this study to generate rich data from multiple sources of both quantitative and qualitative type. The quantitative approach involves the use of questionnaires. The qualitative aspects of this study consisted observation of the researcher and interviews with local Kebele leaders, and town administrators. As a result, it is difficult to use strictly qualitative or quantitative approach solely to make a research analysis for a given problem. Therefore, it is critical in this kind of research, to integrate both aspects of qualitative and quantitative analysis techniques in order to reasonably describe and understand whether and to what extent urban sprawl trends exist in study area.

3.3. Types and Sources of Data

3.3.1. Spatial Data Sources and Sampling Techniques

Reliable data is necessary to realize the designed objectives of the study. Hence, this study was based on the integration of both spatial and non spatial data source. Therefore, the key source of spatial data was Landsat7 ETM^{+} images (2001) and 8 Operational Land imager (OLI) _ Thermal Infrared Sensor (TIRS) image of (2017) which are obtained from USGS and spatially referenced in the Universal Transverse Mercator (UTM) projection with datum World Geodetic System (WGS) 1984 UTM zone 37N. These images were acquired from the period January–February, as this time a region has a clear sky season which reducing atmospheric and radiometric problems. Thus these images were extracted in Tiff format.

The key reasons why the researcher selected Landsat 7 ETM^{+} image of 2001 its conduciveness for comparison of changes and patterns, due to its constant spatial and spectral resolutions. Beyond more Landsat 8 will continue and advance the collection of Landsat data with a two-sensor payload. OLI is collect images using nine spectral bands

in different wavelengths of visible, near-infrared, and shortwave light to observe a 185 kilometer (115 mile) wide swath of the Earth in 15-30 meter resolution covering wide areas of the Earth's landscape while providing sufficient resolution to distinguish features like urban centers, farms, forests and other land uses. However, TIRS was added to the satellite mission when it became clear that state water resource managers rely on the highly accurate measurements of Earth's thermal energy (Zhiming, 2013). In addition to the above reason these, Landsat image has better resolution than the before Landsat images. For this Mohsen (1999) and image Copyright © NASA (2013) provided their idea in the following manner respectively the most widely used satellite image for land-cover/land detection analysis and urban study is Landsat 7 ETM^{+} images 8 Operational Landsat Imager (OLI) Thermal Infrared Sensor (TIRS). In general the detail properties of image are summarized in the table 3.2. Farther more within this study period there is rapid urban expansion related to urban land policy change which is the major factor to increase urban land demand and caused rapid urban expansion to our home country Ethiopia. Before in 1991 every land was managed by the government only but after 1991 land ownership changed in to people; specifically urban land has been acquire through the means of lease, tender, allotment, auction, negotiation, transfer, award, these are the factor for current urban expansion. Hence, this and the above factors are enforced the researcher to delimited this time series year.

Another source of spatial data was GPS points and, DEM. Thus, basic reason behind used GPS points is for the sake of ground verification during LU/LC changes detections of the study area. So in order to taken the ground truth data of the study area, information which were obtain from field observation and supervised classification had been used to determine the LU/LC classes. Beside this, the ground truth data was used for validating the supervised classification while land use/cover map had been produced. This is because of increasing the accuracy of the ground locations. After all, ground truth data had been taken using Garmin GPS 60 for the study area for effective ground location.

Table 3.2: Characteristics of Landsat Imagery

Sensor	Acquisition date	Spatial resolution	Path/Row	Source
Landsat7(ETM+)	14/02/2001	30 m and 15m pan	169/53	USGS
Landsat8-(OLI and TIRS)	1/1/2017	30 m and 15m pan	169/53	USGS

Source: USGS

3.3.2. Ground Truth Data Sampling Techniques

In order to take the sample ground truth points to each land class simple random sampling technique was used. So as to taken the ground truth data, reconnaissance survey was conducted. Having this field observation, ground truth points of each land class had been taken using Garmin GPS 60 instruments after determined of the land use classes and the observation of overall nature of urban sprawl situation in the study area. At least 50 GPS points must be take for each land class according rule of thumb. But the researcher had taken 20 GPS points for each land class and a total of 80 GPS points due the time delimitation of the material obtained office i.e. Debre Markos House construction industry office which is found in Debre Markos bus station.

3.4. Soft Ware's Used to Analysis Spatial Data

So as to analyze the collected data the researcher utilized like: Arc GIS 10.3 and RS Erdas 9.2 soft ware.

3.4.1. Image Pre-processing

At first, Landsat images were downloaded from USGS by used path 169 and row 53. As a result, Landsat imageries of 8(OIL_TIRS) and7 (ETM+) were used and acquired in all most the same season and the same level of resolution for the periods 2001and 2017. Thus, it was favorable for comparison of changes and patterns occurred in the time

beneath analysis part of the thesis. Secondly, for the sake of enhancing the accuracy of the features layer stack was run for each bands in to make it in to one layer stack using Erdas imagine 9.2soft wares. Furthermore geo-referencing of the coordinate system for each GIS data layers had been performed. Geo-referencing entails makes sure that all spatial data layers use the same coordinates of the map projection. Therefore, all the data sets had been projected to WGS 1984 UTM Zone 37N by Arc GIS 10.3 Data management tool to avoid image distortion and have the same geographic coordinate system. The spatial extent (area of interest) covering the entire Debre Markos Town has been extracted from the images using spatial analyst tool in Arc GIS 10.3.

Following to this the images was composed in different ways in order to identify surface features in the study area. True color composite usually known by RGB 321 combination where band 3 reflects red color, band 2 reflects green and band 1 reflects blue color but the researcher used false color combination (415), in landsat 7(ETM+) band 1 represent blue, 4 = Near IR and 5 middle IR but in land sate 8 costal, read and near IR respectively. The researcher used this false combination is that in order to obtain better visualization, interpretation and classification of the image, this band combination utilized specifically for urban study (James, 2010). Thus this remotely sensed image had been used and processed for identifying urban land use/land cover change and to identify the rate and also the patterns of sprawl on the study area.

3.4.2. Image classification

To identify changes in the land use/cover at different years, post classification comparison of the change detection techniques was used. (Adamu, 2010) argued that change detection is the most common approach used to compare data from different source and dates. The help of post classification techniques is that it by passes the associated difficulties with the analysis of images obtain at different times.

Erdas imagine 9.2 Software had been used for image pre-processing, and classification. Supervised classification performed using maximum likelihood classifier. The two images were classified into the same land use types. Supervised classification allows natural spectral clusters to be distinct with high degree of objectivity (Hudak&Brockett,

2004). This method of classification involves the procedure of identifying pixels possessing the same spectral features. Erdas imagine software is used in digitally processing and identifying the spectral clusters on the Landsat images. By carrying out this classification, the signature editor was used through the classifier icon of the Erdas imagine to identify the spectral signature of different features. Maximum likelihood algorithm is used to classify the images and the digital numbers of the pixels is grouped with pixels arranged and organized otherwise known as land cover classes.

Based on Anderson et.al (1976) land use/land-cover classification scheme, the various land-use/land-cover types is modified in to five classes. Based on the prior knowledge of the study area and a brief reconnaissance survey with additional information from elders, a researcher classified land use land over in to four classes based on the relevance of the study area and namely Built-up area, Farmland, Vegetation and Open land. As a result, Arc GIS 10.3 analysis tool were used to reclassify the classified image and integrate different data sets (land class) to map urban sprawl. The type of land class of the study area and their definition had been listed on table3.3. Finally, the extent of urban sprawl of the two images was analyzed quantitatively in hectares by the help of Arc GIS 10.3 spatial analysis tool (raster calculator) to establish the relationship between urban sprawl and land-use change along with, the pattern urban sprawl had been determined through overlay of two year urban sprawl maps and visual interpretation carried.

Table 3.3: Land Use/Land Cover Classes Descriptions of Study Area

Code	Land use categories	Description
1	Built-up area	Land use for residential and transportation/communication purposes (i.e. settlements and roads, high residential area, industry and administrative block).
2	Farmland	Areas with cultivated agriculture
3	Vegetation	Natural and manmade forests, natural grasslands, woodland shrubs, sparsely planted trees etc.
4	Open land	Open spaces with little or no vegetation, beach, dunes sands, bare rocks, sparsely vegetated areas. (Refers to non-built-up land with no, or with insignificant, vegetation cover).

Source: Modified from Anderson et.al (1976)

3.4. 3. Accuracy Assessment of Classified Land Use / Land Cover Map

The use of remote sensing data and techniques has made geospatial analysis easy and more powerful, but during the time of Land use classification the researcher faced to different type of error. In order to avoid this errors accuracy assessment is mandatory so as to make the produced land cover map reliable and easily understandable by the users. As a result, the accuracy assessment done in the Arc map by integrated the classified land sat image, Google Earth and Ground control points. The result was assessed by comparing the supervised classification with the ground control points by used error matrix. But the socioeconomic data of the respondent were assessed by cross checking with secondary data source and based on researcher's personal filed observation. Producer accuracy indicated that how much the researcher (producer) classified correctly each land use class (pixels) during the time of supervised classification. It had been calculated the number of correctly classified pixels in each class (category) divided by the total number of pixels that were classified in that category of the classified image (column total). Users accuracy refers to the number of correctly classified pixels in each class (category) divided by the total number of pixels that were classified in that category

of the classified image (row total). It represents the possibility that a pixel classified into a given category in reality represents that class on the ground. Over all accuracy is calculated by dividing the total number of correctly classified pixels (i.e., the sum of the elements along the major diagonal) by the total number of GPS points that were taken for each land class. It gives an overall product of the tabular error matrix.

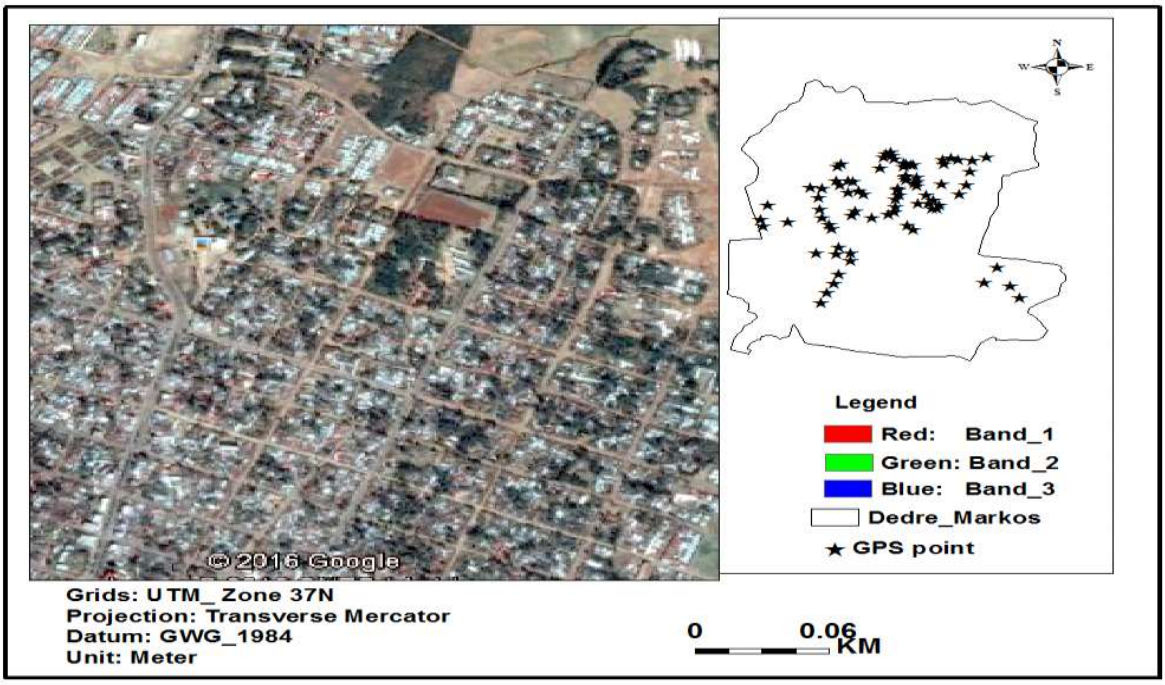

Figure 3.3: Google Earth Image and GPS Points

Source: From Google Earth, and Filed survey, 2017

3.5. Socio-economic Data Source and Sampling Technique

Non spatial data source incorporated both primary and secondary data sources. Primary data which were the major source of the study were collected through Key informant interview, using questionnaire and personal observation, of study area; on the other hand Secondary data's collected from both published and unpublished materials such as; books, internet, CSA, kebeles, research reports and municipality official reports.

3.6. Sample Size and Sampling Technique

The researcher used probable and non- probable sampling methods to select the study participants. Two kebeles were selected purposively from seven kebeles of the town which are kebele 03 and 07. As a result, these two kebeles 03and 07 are found relatively on flat area that make them suitable for urban expansion and that's why purposely selected for this study. Farther more, purposive sampling was used to select key informants from government officials and elders of the community. For the reason that, experts and office head who are directly working on the issue believed to have rich data than the others. Lastly, 11 people participated in the key informants‟‟ interviews. more particularly, two from municipality of the town, three from Debre Markos House construction office, four from community elders, and two from kebele administration.

3.6.1 Sampling Frame

The sampling frame of this research was taken from the households of living in kebele 03 and, 07.

3.6.2. Sampling Unit

The sampling unit was the households of the stated kebeles of the target Population who lives in these kebele; in order to get specific information.

3.6.3. Sample Size

Representative samples were taken from the households of the selected kebeles; based on scientific formula at required degree of confidence. According to Debre Markos town administration office household report of 2016 the number of households who live in kebele 03 and 07 kebeles are around 3 thousand two hundred thirty-three. Thus, representative sample of these households was calculated based on formula for sample size determination and for finite population. According to Yamane, (1967) formula i.e. 93% confidence level and 7% precision level were used as a criteria. As a result the sample size was calculated as follow.

$$n = \frac{N}{1 + N(e)2}$$

Where: n = is the required sample size

N = target population of the study

e = margin of error (0.07)

$$n = \frac{3233}{1 + 3233(0.07)} = 192$$

Hence, 192 households were participated in the in this survey.

3.7. Socio-economic Data Collection Instruments

The investigator used the following data collection instruments in order to achieve the stated objectives of the study. These were: questioner, interview and filed observation of the study area.

3.7.1. Questionnaire

The investigator used both open ended and close ended questioners to the selected participant. To obtain information on effects of urban sprawl on farmers' production, income and quality of life in relation to their activities and farming land. The main reason to use the close ended questioner to increase the uniformity of the response and useful for quantitative analysis and also open ended questioner is important to dig out the respondents idea about the problem. However, the researcher used similarly questionnaire for all respondents of the selected samples. The questionnaires prepared both in English and Amharic languages in order to obtain the required information. After the questionnaire distributes to the respondents the researcher collected it by herself.

3.7.2. Interview

The researcher used only structured interviews to distribute the same question to the respondent. These interviews prepared for affected communities, experts of the municipality, community leaders and Kebele administration.

3.7.3. Filed observation

Direct observation is the most reliable methods for gathering information related to the problems. So the researcher observed and collected the necessary visual information with the help of camera. Observation used by the researcher in order to get more information to accurate the information gotten from the other tools.

3.8. Analysis of Socio-Economic Data

The primary data collected was processed and analyzed through the use of Statistical soft ware and products like: SPSS, V 20 and Microsoft Excel. SPSS soft ware has its' own tools to analysis the collected data like: data view which used to code the collected data, variable view utilized to put the coded data and finally analysis tool processes the coded data and give the results. The Qualitative data is records, transcribe and use as integral parts of write text to better understand patterns, and relationships between variables. Direct quotations from respondents were also used to analyze qualitative data.

3.9. Socio-economic Data Reliability Assessment

Checking the validity and consistency of data collecting instruments before providing to the actual study subject was the center to know the excellence of the data. Therefore, the primary data collected through questioners had been crosschecked through interviewing with information gathered from public records and published materials on the issue of pixels to the wrong classes.

3.8. Ethical Considerations

Ethics in research deals with how the researcher treats those who participate in the study and how to handle the data after collection (Muhidin, 2016). In this study different ethical consideration had been taken. In the first place, to get informed consent from the study participants, the first thing was clearly described the purpose of the study, informing the purpose of the data take from them as the educational relevant and describe of about myself and where I came. This method helps me to gotten smooth relationship with the participants and accurate information from them. In addition to this during the time of interview participants were informed to freely respond the question raise and also notify that they have the right to stop during the time of discomfort. The least but not the last ethical consideration is participant and data confidentiality. During interview, voice record was used based on the consent of the participant. Hence, their names keep confidential and except of informants, code names used.

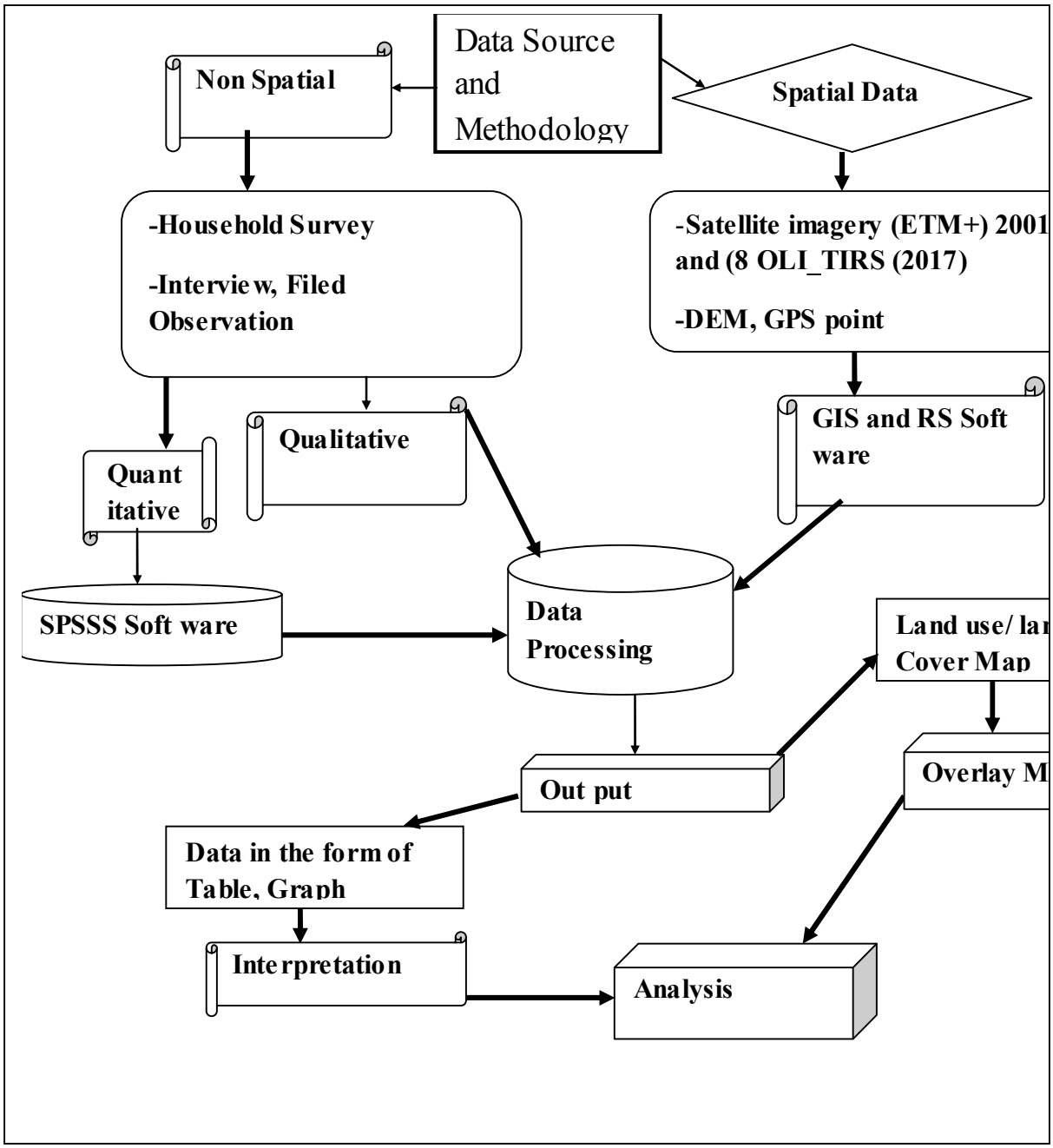

Figure3.5: Data Source and Methodological Flow Chart

Source: Researcher Own Construction, 2017

CHAPTER FOUR

4. DATA ANALYSIS AND INTERPRETATION

This chapter is dedicated to the analysis of both qualitative and quantitative data that was obtained from sample respondents taken and satellite image related to urban sprawl and its impacts on surround communities of Debre Markos town. The presentation of results and discussion had been carried out under the following subthemes: socioeconomic data and satellite image analysis. Socio-economic data were analyzed by using SPSS soft, ware's, micro soft excel and interpreted in the form of descriptive statics like table, bar graph frequency and percentage but satellite image had been analyzed based on Erdas imagine 9.2and Arc GIS 10.3 soft ware tools and interpreted by using Excel, in the form of figure and tables. These satellite images analyses depending on each land class and by using built up area an indicator (index) to measure the extent, rate pattern of urban sprawl and its change detection.

4.1. Analysis of Spatial Data

4.1. 1. Land Use/ Land Cover Classification

The classification outcome of the 2001 image presented that, farm land constituted the prime share of land cover in the study area with a rate of 45.01%,(11863.35 hectare) followed by Open land which accounts for 30.37% (7995.24 hectare) as showed in the table 4.1 and the remained land class built up and vegetation contained 12.01% (3307.5 hectare) and 12.57% (3163.05 hectare) respectively.

The classification result of the 2017 image revealed that farm land constituted with a rate of 37.27%, (9811.53 hectare) Open land which accounts for 25.21 % (6636.87 hectare) as showed in the table 4.1. The other land class built up and vegetation contained 22.61 % (5952.69 hectares) and 14.92% (3928.05 hectare) respectively. When compared each land use cover from 2001 to 2017 farm land decreased from 45.01% to 37.27% nevertheless, in the reverses built up area increased from 12.01% to 22.61% , open land decreased with a rate 30.37 % to 25.21% and vegetation increased from 12.57% to 14.92%. Farmland was the most dominant land cover class in the study area (2001) yet, now decreased

progressively as indicated table 4.1 from 45.01% to 30.37 in 2001and 2017 respectively. In the reverse, built up areas have vigorously increased in the study periods. Therefore, the researchers concluded that the main cause of decreasment of farm land is due to the successive consumption of through by built up area specifically residential housing purpose.

Table4.1: Spatial Extent and Percentage of Land Use/ Cover (2001and 2017)

	2001		2017	
Land class	Hectare	Percent	Hectare	Percent
Built up area	3163.05	12.01	5952.69	22.61
Vegetation	3307.5	12.57	3928.05	14.92
Farm land	11863.35	45.058	9811.53	37.27
Open land	7995.24	30.37	6636.87	25.21
Total	26329.14	100	26329.14	100

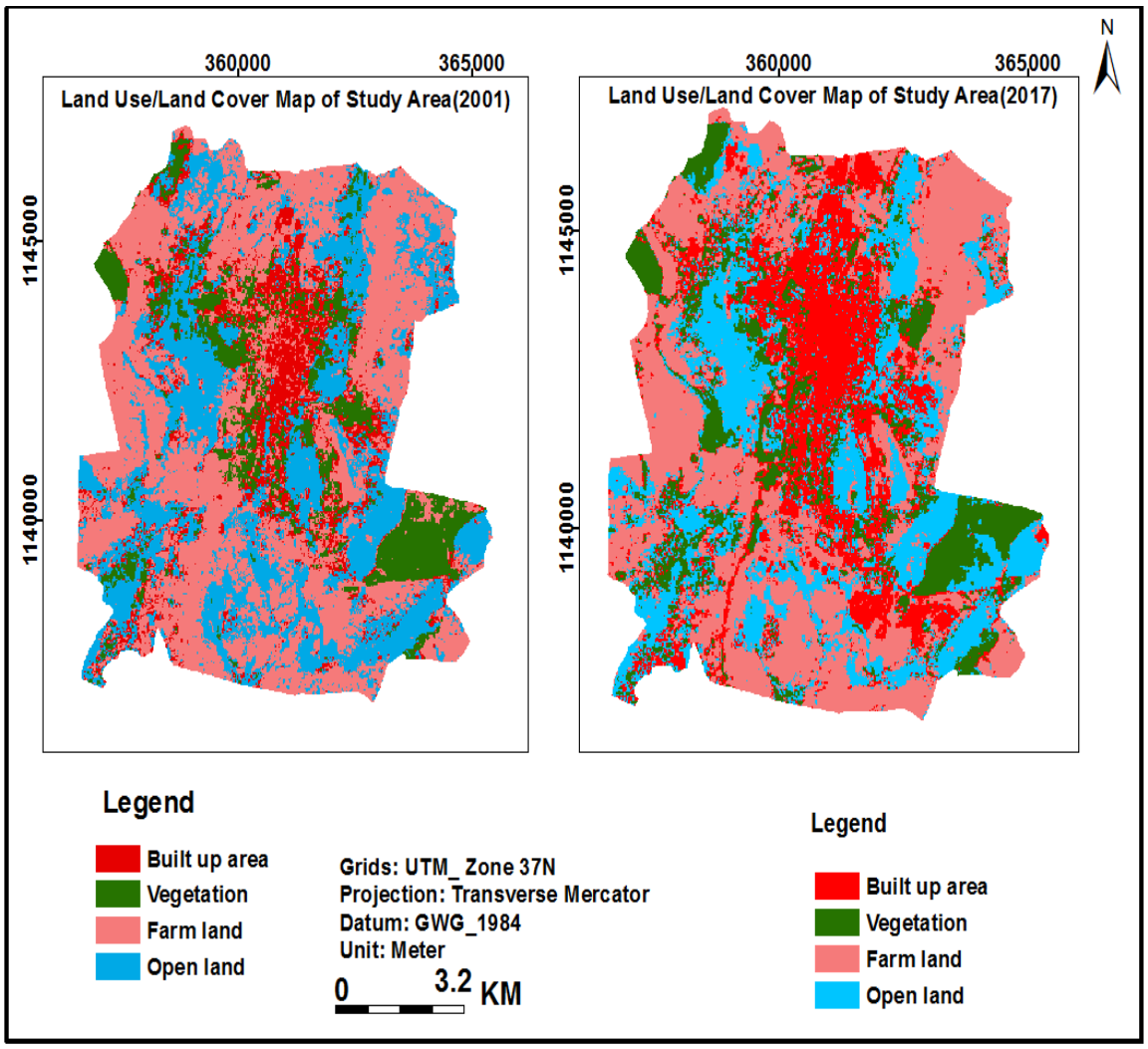

Figure4.1: Land Use/ Land Cover Map of Study Area (2001 and 2017)

Source: Landsat Imagery (2001and 2017)

4.1.1 .Producer's, User's, and Over All Accuracy of the Classified Map

As the table indicated 4.2, the producer accuracy open land was misclassified that is 85.7% when compared to other land classes in 2001 land use classification due to spectral similarity with other land class but built up area high accuracy, while on 2017 land use image classification forest has low accuracy but the remained had good accuracy. As showed on the table 4.2, vegetation had low accuracy that is 89.5% in 2001 land use classification. While in 2017 land use classification open land had low accuracy compared to other land classes i.e. built up area, vegetation and farm land. Because the presence of spectral inseparability.

The overall accuracy of the study period was 90% and 88.8% in 2001 and 2017 respectively. As stated by Anderson *et al*. (1976) for a consistent land cover classification, the minimum overall accuracy value computed from an error matrix should be 85%. Hence, the overall accuracies for the study period land cover maps were above 85% based on Anderson's criteria. Therefore, the ways of classification system that the researcher followed was good based on the above criteria.

Table4.2: Confusion (Error) Matrix of Land Cover Map of 2001 and 2017

Classified map		Ground truth				total	User accuracy (%)
		Built up	Vegetation	Farm land	Open land		
Built up area	2001	18	1	0	1	20	90%
	2017	18	1	0	0	19	94%
Vegetation	2001	1	19	1	1	22	86.4 %
	2017	0	17	1	1	19	89%
Farm land	2001	0	1	17	1	19	89.5%
	2017	0	1	18	1	20	90%
Open land	2001	0	1	0	18	19	94.7%
	2017	2	1	1	18	22	81.9%
Total	2001	19	22	18	21	80	
	2017	20	20	20	20	80	
Producer accuracy	2001	94.74%	86.4%	94.4%	85.7%		
	2017	90%	85%	90%	90%		

Over all accuracy	2001	90%	
	2017	88.8%	

Source: Authors Analysis

4.1.3. The Spatial Extent of Built up and Non Built up Area

Built up area embrace commercial, residential, road and resistant features, Continuous and discontinuous urban fabric, Bus stations, road networks and other associated lands, construction sites, non built up area cover Irrigated and rain fed arable lands, crop land with permanent crops, farming and fallow fields, Natural and manmade forests, natural grasslands, woodland shrubs, sparsely planted trees, sands and rocks. The increment in migration, natural population increase, change of urban land policy and a little improvement of infrastructure increase the rapid urban sprawl in Debre Markos town from time to time. This has contributed to a major expansion of built up land use in the distinct study period.

As a result, there is a need to investigate and quantify the spatial extents of built up and other land cover classes within this study periods. This helped the researcher to assess the trend Urban sprawl from the past to the present position. To achieve this, a reclassification was made to produce land use and land cover maps of built up and other land cover classes. Thus, total quantitative extent of built up and non built up area in each study year has indicated as in the table 4.3. In the 2001 study period the extent of built up area was 3163.05 hectare (12.03%), at the same time other land cover classes accounts 23166.09 hectare (88%) of the total land. While, in 2017 study time the spatial extent of built up area was 5952.69 hectare (22.61%) of the total land cover, in the same conduct non built up area was 20376.45 hectare (77.4%) of the study area land cover.

Thus, as showed from the table 4.3, the spatial extent of built up area was increased from 3163.05 hectare (12.03 %) to 23166.09 hectare (22.61%,) this indicated that the extent of built up area double itself within a short study period i.e. within 16 year intervals and also its total land consumption from other land use inside of a short period of time. However, in the reveres other land cover classes decline from 23166.09 hectare (88%) to 20376.45 hectare (77.4%) in 2001 and 2017 study occasion respectively. To generalize the extent

of built up area increased from the begging of the study to the end of study period with consuming of other land use classes listed in the land use classification above, i.e., vegetation, farm land and open land.

Table4.3: Spatial Extent and Percentage of Built up and othe Land Cover Classes of 2001 and 2017

Land class	2001		2017	
	Hectare	Percent	In hectare	Percent
Built up area	3163.05	12.03	5952.69	22.61
non Built up area	23166.09	87.97	20376.45	77.39
Total	26329.14	100	26329.14	100

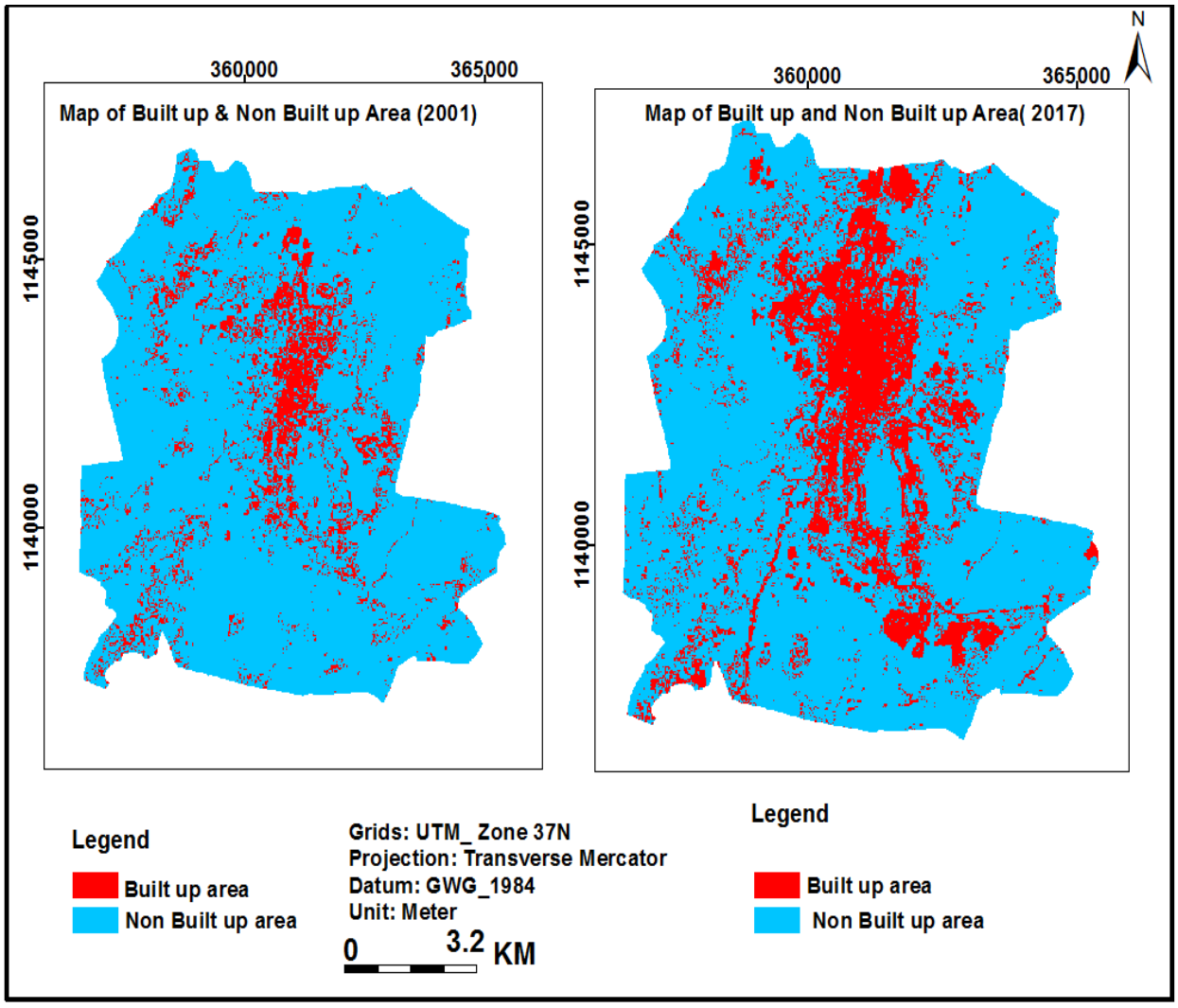

Figure 4.2: Land Cover Map of Built up and Non Built up Area (2001 and 2017)

Source: Landsat imagery (2001 and 2017)

4.1.3.1. The Spatial Extent of Built up Land Use /Cover (2001- 2017)

The extent of built up area expressed in terms of quantitatively in the form of hectare and percent unit measurement in the table 4.4. As the analysis indicated that the extent of built up land cover progressively increasing throughout the study period as shown on table 4.4. In the first study, period which had small extent of built up land cover which constituted 3163.05 hectare (12.01 %) This was followed by the years 2017 (16 years afterward) where the extent of built up area rapidly increased to 5952.69 hectare (22.61%). This rapid increase had accounted by the increase in the construction of

residential house for migrants and for construction of different private and public investment building.

Table4.4: Spatial Extent and Percentage of Built Land Use /Cover 2001- 2017

	2001		2017	
	Hectare	Percent	In hectare	Percent
Built up area	3163.05	12.01	5952.69	22.61

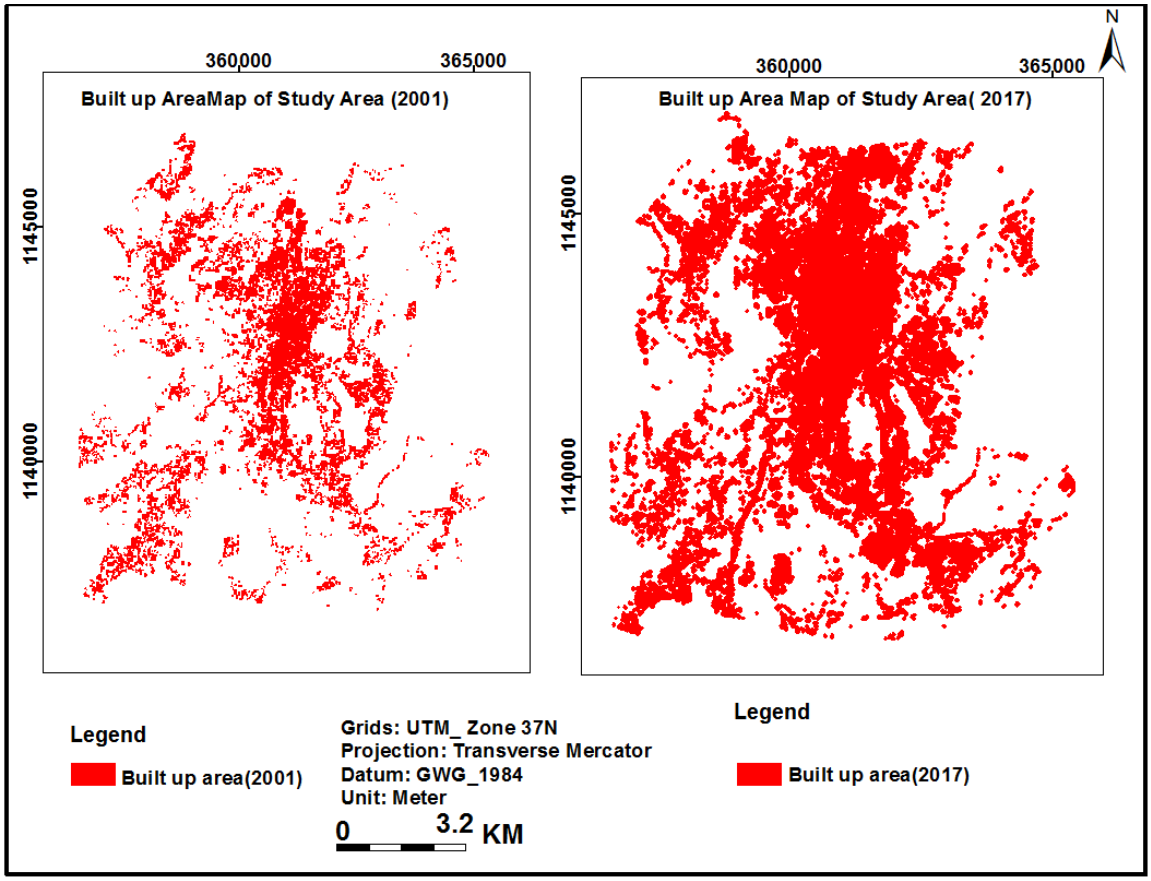

Figure 4.3: Built up Area Map of Debre Markos (2001 and 2017)
Source: Landsat Imagery (2001 and 2017)

4.1.3.2. The Impact of Built up Area on Other Land Use Change

The study area has experienced spatial increase of different land use and land cover classes such as; built up areas, because of the presence of rapid horizontal urban

expansion (sprawl) of the town between the study periods. This increasemente of urban sprawl in forced the built up area coverage to increase and to consume other land use. The areal consumption of built up area in each land use has indicated detail in the table below. As the table4.5, indicated that 788.13 hectare (18.19%) of vegetation were changed into built up area, 2422.62 hectare (58.13%) of farm land and 956.88 hectare (22.96%) of open land within this study period. The vital aim of change detection is to know what was past and what the present situation of each land use cover of the study area. As a result 788.13 hectare (18.19%) of the land cover of the study area is vegetation in the past i.e. in 2001 and before; although, know changed into built up area related to the uncontrolled urban sprawl. In the same manner 2422.62 hectare (18.91 percent) of land cover of the area is farm land but at this time changed in to built up area and also 956.88 hectare 22.96% of land use was open land however, know changed in to built up area.

To sum up Agricultural land cover change (lost) is the primary one followed by open land. The issue of farmland loss was also confirmed by the result of the questionnery conducted in the surrounding farming communities and this was largely attributed to the horizontal expansion (sprawl) the Debre Markos town. On the relationship between Debre Markos town expansion and loss of farmlands, 87.0% of the respondents credited to the loss of their farmlands to the expansion of Debre Markos town with the remaining 13% giving a contrast view related to this issue as explained in the second part of this chapter.

Table 4.4: Other Land uses Changed in to Built up Area

Land use class	In hectare	In percent
Vegetation	788.13	18.91
Farm land	2422.62	58.13
Open land	956.88	22.96
Total land class changed to built up area	4167.63	100

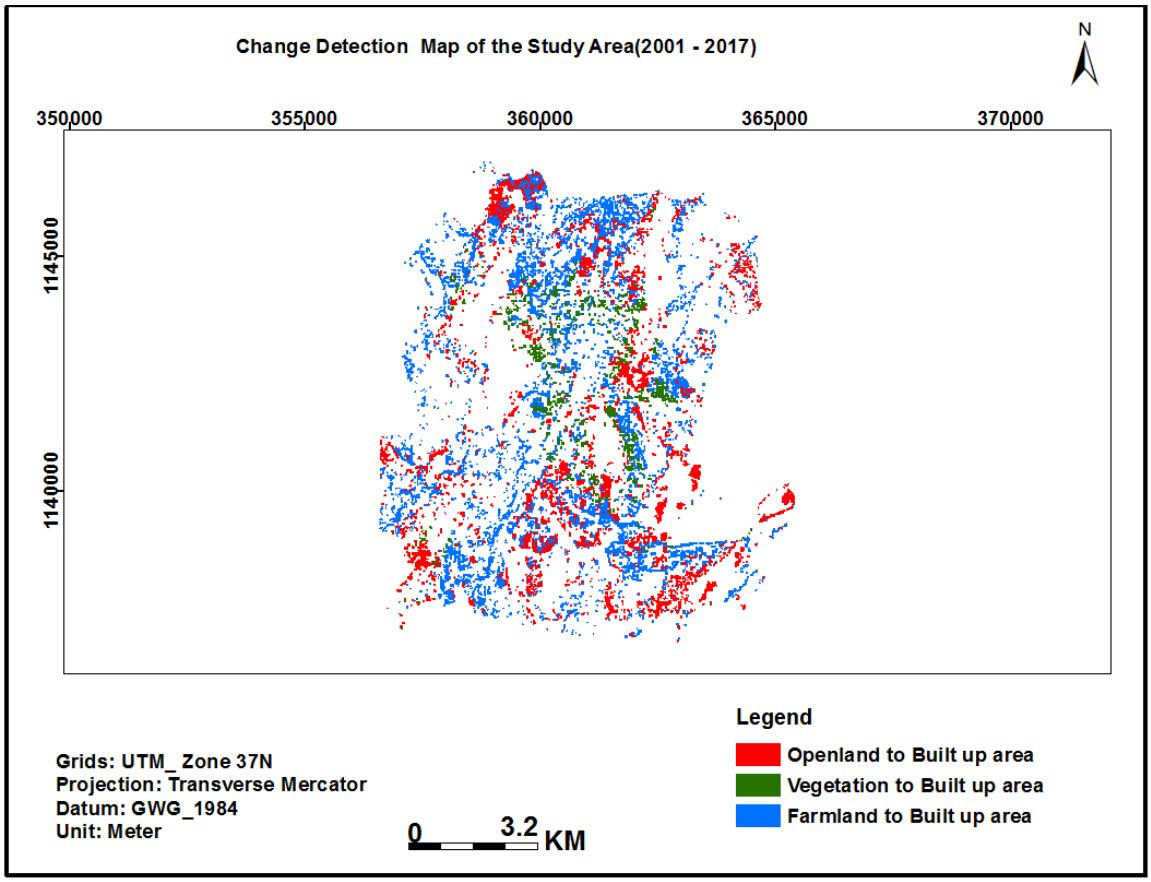

Figure4.4: Change Detection Map of Study Area (2001- 2017)

Source: Landsat Imagery (2001 and 2017)

4.1.3.3. The Entire Change of Each Land Use Classes (2001- 2017)

The main reason for produced post classification maps from images of two different time periods was to decide how past and present land use/ cover (farmland, built up areas and vegetation and open land use) modify due to human activities. These post classified maps were additionally used as inputs in a change detection analysis to determine how individual land cover/use classes may have changed through time and at what spatial extent. Therefore, this change detection analysis result has been summarized as follows in the next table. This table indicated that the total gain of each land use from other land use in the form of hectare or percent i.e. Built up area from forest , farm land and open lands, at the same time forest land use obtained from this land classes but also open land. While

as it shows its total gain but also indicates total loss of each land use as well as its net change within these study period.

As the table4.6, illustrates that from the total four land use classes two of them decreased during the study occasion. Hence, farm land 30.1% and open land 19.9% decreased over the study period. However in the reverse built up area and vegetation increased to 40.9 % and 9.1% within sixths year time interval. According to the evidence obtained from interview the key in format in the time of filed survey, the main increasemente of vegetation for the reason that, farmers used as vegetation as a means of cash income source rather than production of crops on farm land and related to government green land policy specifically that was revised 2000 E.C. For the reason that, most of the farmers perceive that growing of vegetation have three way income sources (benefit), i.e. during the time of seedling: plantation and after the vegetation selling reach to mature. As the table below indicated that, farm land decreased over this study time interval because of over expansion of built up area during this study time.

Table 4.6: Spatial and Percentage: Total Gain, Los and Net Change of Each Land Class

	Persistence		Gains		Losses		Net Chang	
Land cover type	In Ha	In%	In Ha	In %	In Ha	In %	In Ha	In%
Built up area	1785.06	11.592	4167.63	38.13	─2789.6	─22.6	2789.6	40.9
Vegetation	1770.21	11.495	2157.84	19.74	─1537.3	─12.5	620.6	9.1
Farm land	7520.67	48.84	2290.86	20.96	─4342.7	─35	─2052	─30.1
Open land	4322.79	28.07	2314	21.17	─3672.5	─29.8	─1358.4	─19.92
Total	26329.14	100	10930.03	100	─12342.1	─100	0.0	0.0

Source: Dejene, 2016 modified by the researcher

Net gain = the sum of gained from each land class ÷ the total class gained

Net Los= the sum of lost from each land class÷ the total class lost

Net change = the sum of gained from each land
class−the sum of lost from each land class

4.1.4. The Spatial Extent and Rate of urban sprawl in Debre Markos town

The scope of urban sprawl is illustrated based on changes (increase) or decrease of built up area in the study time. The analysis reveals that the extent and rate of urban sprawl in the study area increased substantially. As shown in Table 4.7, the study area sprawled by 2789.64 hectare (88.2% at a rate of 5.5% each year from 2001- 2017 in the study area. In addition to this entire respondent responds that in the study area urban sprawl really exists. As table 4.14, shows 40(20.8%) of the respondent said that the main cause of the current rapid urban sprawl of Debre Markos town is natural population increase,17(8.9%) of them said industrial expansion and increasemente of private investments, the rest of 135(70.3%) were concern rural to urban migration due to the need to employment. In addition to this other information obtained from the key informants responded that more urban expansion existed following with the construction of Debre Markos University. Farther more, Debre Markos town administration report (2017) declared that75% of the town physical land setting is more suitable for construction and investments. This is main factor for the current rapid urban sprawl in this particular town. Remember, this increasemente of urban sprawl is not only contained horizontal sprawl as well as its vertical expansion of the town. Generally the total expansion of the town within the sixths duration 88.2% while, it's annually increasemente was 5.5% per year.

Normally, as shown in the figure4.5, much of the physical growth of the town is observed towards Northern and Southern direction and there is little change in Western and Eastern directions of the town due to the natural land escape constraints. Hence, 20% of urban land covered by mountains and the remained 5% enclosed swampy areas (mainly flood plains) and to some extent ridges, escarpments, and streams associated with gullies.

Usually these constraints are the major factor that restricts the development of Debre Markos town in all direction of the land escape.

Table4.7: Spatial Extent and Rate of Urban Sprawl in Debre Markos Town

	Extent of urban sprawl		**Level**	**Rate of urban sprawl**
Year	in Ha	in %	in Ha/year	in%
2001-2017	2789.64	88.2%	174.4	5.5%

Source: Authors Analysis

The formula that was used to obtain the extent of urban sprawl is that base year (2001) extent of built up area minus the extent of reference year (2017) in hectare. At the same time the formula that is used to change in to percentage is that ((Difference in the extent of built up area during 2001-2017)/ extent of built up area in 2001)*100

Level of urban sprawl= extent of urban sprawl over number of years i.e.

2001-2017÷16= 2789.64÷16= 174.4 hectare per year

Speed of urban sprawl during a given period is defined as percentage change (per year) in the level of urban sprawl. Thus, the speed of urban sprawl during 2001-2017 calculated as follows: Speed of urban sprawl, 2001-2017= ((Difference in the extent of built up area during 2001-2017)/ extent of built up area in 2001)*100÷ 16), adopted from Adamu (2010) but modified by the writer.

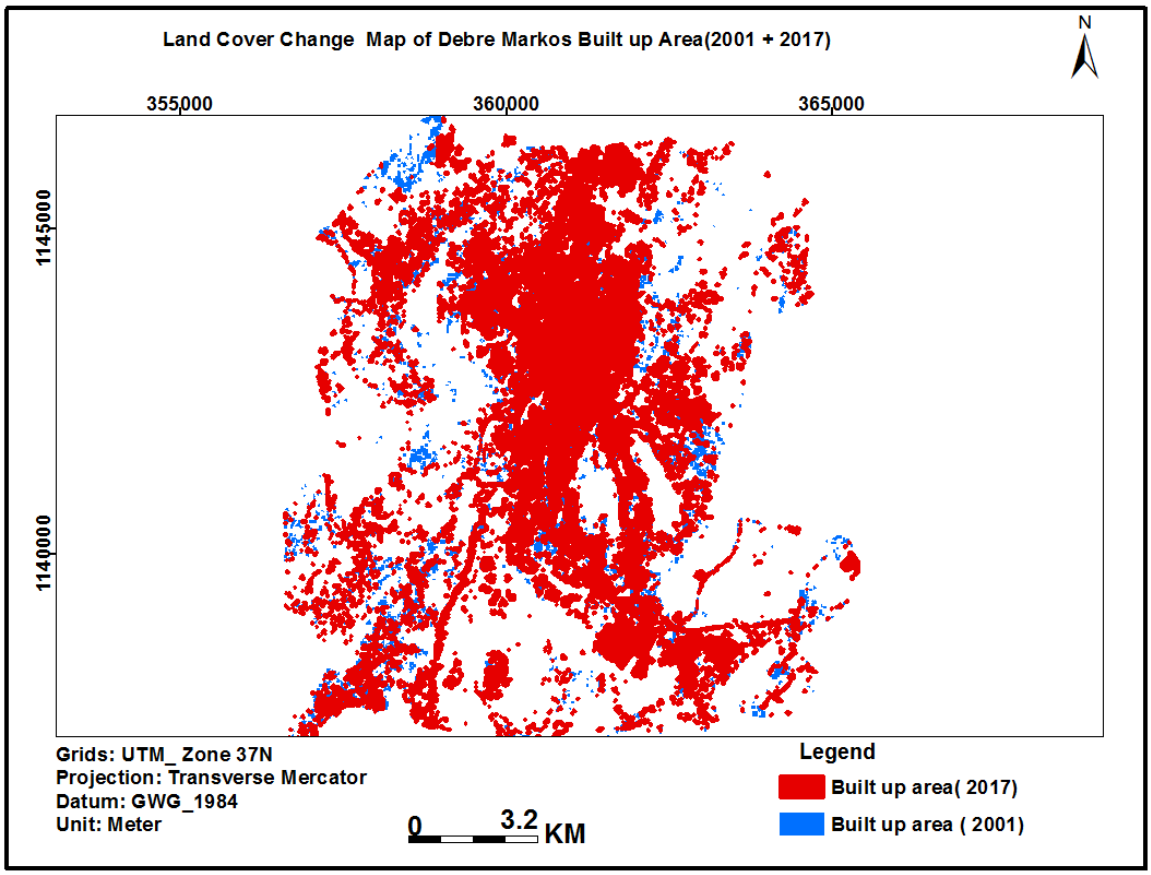

Figure4.5: Land Cover Change Map of Debre Markos Built up Area (2001 + 2017)

Source: Landsat Imagery (2001and 2017)

4.1.5. Spatial Pattern of Urban Sprawl of Debre Markos Town 2001 - 2017

In order to identify the pattern of urban sprawl in the study area the researcher used these methods of indicators: the shape change of built-up area, fragmentation and open space efficiency. Thus, pattern of urban sprawl was derived from the two imageries of the study area overlays analysis. Hence, visual interpretation was carried out to determining the patterns of the urban sprawl. As a result, knowing of the Pattern of urban sprawl helps us to identify the spatial distribution ones country urban land use development. Based on result obtained on this analysis the town sprawl characterized by three type of urban development pattern (contagious (compact), linear and leapfrog) in both study period but their degree is difference. In 2001 compact and leapfrog development was in small

amount. However, 2017 three type of urban sprawl development pattern exist in greater degree than in 2001 study time in the Debre Markos town. Contagious pattern means expansion of existing development from a central core; leapfrog pattern exhibits discontinuous development some way from a historic central core to the periphery; linear form is the development the town along major transport routes. In general the study area characterized by more of leapfrog urban sprawl development ; the reason of leapfrog development had been explained according to Ewing, 1991 as follow; New communities nearly always start up just beyond the urban fringe, where large tracts of land are available at moderate cost .

Based on the nature of the pattern of urban sprawl in the study area, conclude that the pattern of urban sprawl can be said to be continuous disperse development to low density residential units and isolated tracts, separated from other areas by vacant space forming leap frog pattern along the periphery. This affect the structural growth and economic system of surrounding area and lead to the drawbacks by affecting the infrastructural planning and making administration of the study area extremely difficult which is in consistency with the results of the findings in the case of Debre Markos town. For this Pohanka (2004) forwarded a supportive idea, urban Sprawl often occurs faster than development of the infrastructure (e.g. schools, roads, sewer systems, and water lines.)

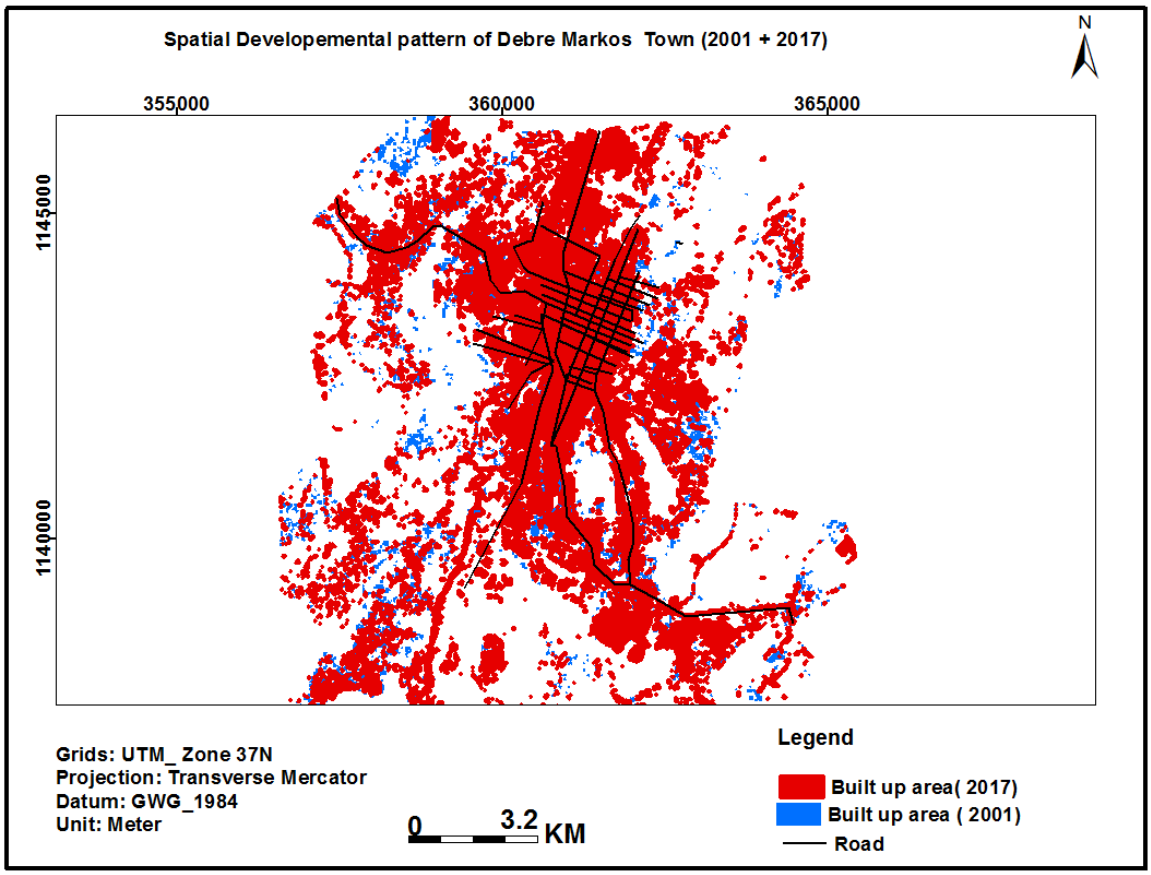

Figure4.6: Spatial Pattern of Debre Markos Town (2001 and 2017)

Source: Landsat Imagery (2001 and 2017)

4.2. Analysis of Socio-economic Data

4.2.1 General Background of Respondent House holds

The participant of this study comprised people with different sex, age category, marital status, family size, education level, and occupation status. Hence, the result had presented as follow.

4.2.1. Proportion of Respondents by Gender (sex)

As figure 4.7: indicated that 136 (70.8%) of the respondent were males and the remained 56(29.2%) were females. Based on this evidence majority of the respondent were males.

However, these gender differences of the participant do not affected the information obtained from them.

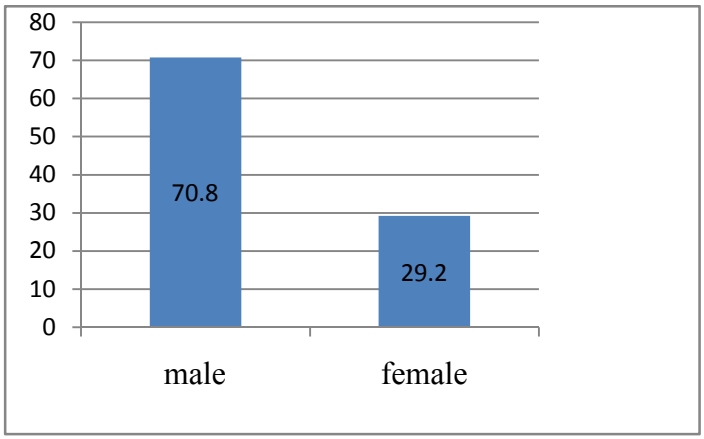

Figure 4.7: Proportion of Respondent by Gender (sex)

Source: Filed Survey March, 2017

4.2.2. Age Structure of the Respondents

The researcher classified the respondents age in to the following five groups: 25-30, 31-35, 36-40, and 41-45 and >46. As we can saw from Table: 4.9, the sample respondent of 25 (13.0%) were grouped under age 25 to 30 the remained were, 37 (19.3%) age 31 to 35, 43 (22.4%) age 36 to 40, 53(27.6) were age 41 to 45 and 34(17.7%) indicated that above 46 age group. Hence, the mass of the participant were 41 to 45 age groups of the study area followed by 36 to 40 age groups.

Table 4.8: Respondent's Age Structure

	Number of respondents			
Age Group	Frequency	Percent	Valid Percent	Cumulative Percent
25-30	25	13.0	13.0	13.0
31-35	37	19.3	19.3	32.3
36-40	43	22.4	22.4	54.7
41-45	53	27.6	27.6	82.3
>46	34	17.7	17.7	100.0
Total	192	100.0	100.0	

Source: Filed Survey March, 2017

4.2.3. Educational Back ground of Respondents

As indicated table: 4.10, most of the respondents are illiterate with 79(41.1%) of from the total participant followed by primary (1-4) school with 50(26.0) percent. Those who gotten access to secondary school (5-8) grades were 31 (16.1%), high school (9-10) shares 20 (10.4%), and preparatory shares 8(4.2%). The remained 4(2.1%) of the respondent had an education level of 12 complete and greater than. Where as to carry out this study, review interview were used to fill the questionnaire for those who could not capable to fill the questionnaire themselves.

Table4.9: Education Back Ground of Respondents

Number of respondent				
Education level	Frequency	Percent	Valid %	Cumulative Percent
Illitrate	79	41.1	41.1	41.1
primary school	50	26.0	26.0	67.2
secondary school	31	16.1	16.1	83.3
high school	20	10.4	10.4	93.8
preparatory school	8	4.2	4.2	97.9
>12 complete an above	4	2.1	2.1	100.0
Total	192	100.0	100.0	

Source: Filed Survey March, 2017

4.4.4. Occupation Status of Respondent

As table 4.10, show that the respondents have inconsistent occupation. The majority of the respondents were farmers 162 (84.4 %) followed by daily labor 20 (10.4%) whereas the remaining small share of the respondent 10(5.2%) are engaged merchant activity.

Table 4.10: Occupation Status of Respondent

Number of respondents				
Occupation	Frequency	Percent	Valid Percent	Cumulative Percent
Farmer	162	84.4	84.4	84.4
daily labor	20	10.4	94.8	94.8
Merchant	10	5.2	5.2	100.0
Total	192	100.0	100.0	

Source: Filed Survey March, 2017

4.2.5. Marital Status of the Respondent

As table 4.11, indicated that most of the respondents are married those are 79.2% of out of the 192 respondents. The remaining 20.8% are unmarried.

Table4.11: Marital Status of Respondent

Number of respondent				
Marital status	Frequency	Percent	Valid Percent	Cumulative Percent
un married	40	20.8	20.8	20.8
Married	152	79.2	79.2	100.0
Total	192	100.0	100.0	

Source: Filed Survey March, 2017

4.2.6. Family Size of the Sampled Respondents

As table 4.12, indicated that the sample respondents, 35 (18.2%) had 1 to2 family size, 54 (28.1%) of the respondent had 3 to 5 family sizes, 49 (25.5%) had 6 to 7 family size, 24 (12.5%) had greater than 8 children's while the remained 30(15.6%) respondents were do not have child. Based on this table most of the respondent had a family size of 3 to 5 followed by 6 to 7.

Table4.12: Family Size of Respondent

Number of respondents				
Family size	Frequency	Percent	Valid Percent	Cumulative Percent
not has child	30	15.6	15.6	15.6
has 1-2 child	35	18.2	18.2	33.9
has3-5	54	28.1	28.1	62.0
has 6-7	49	25.5	25.5	87.5
has child >8	24	12.5	12.5	100.0
Total	192	100.0	100.0	

Source: Filed Survey March, 2017

4.2.2. The Cause and Socio Economic Impact of Urban Sprawl in Debre Markos Town

4.2.2.1. The Cause of Rapid Urban Sprawl in Debre Markos Town

The causes of urban growth are quite similar with those of sprawl. Most of the time difficult to discriminate since urban sprawl and growth are highly interlinked. On the other hand, it is important to realize that urban growth may be observed without the occurrence of sprawl, but sprawl must induce growth in urban area. The first and foremost reason of urban growth (sprawl) is increase in urban population. Rapid growth of urban areas is the result of two population growth factors: (1) natural increase in population, and (2) migration to urban areas. Natural population growth results from excess of births over death. Still the high growth rate of urban population is mainly accredited to rural-urban migration which is up to know the predominant cause in developing countries to increase the size of urban population. In Ethiopia, the urban population has been growing in recent years at an annual rate of 7 percent mainly because of rural-urban migration. In migration accounted for 4.5 percent (Bhatta, 2010).

In case of the study area following the same trend of urbanization, most of the in migrants to Debre Markos town were rural origin. According to Teferi, Aderaw (2013) finding at that particular area, from the total migrants (11325) about 50 percent were from rural origin. in the same way, the key informants and the participant response revealed that 135(70.3%) replied that the main cause of the rapid urban sprawl of Debre Markos town is rural to urban migration related to seek out for employment, 40(20.8%) of the respondent identified natural population increase as the main cause for urban sprawl and the rest 17(8.9%) of them act in response to industrial expansion and increasemente of private investments. Hence, the main cause of urban sprawl intended for the study area is rural to urban migration.

Table 4.13: Cause of Rapid Urban Sprawl in Debre Markos Town

	Number of respondents			
The cause of rapid urban sprawl in Debre Markos town	Frequency	Percent	Valid Percent	Cumulative Percent
Natural Population growth	40	20.8	20.8	20.8
industrial expansion and increase of private investments	17	8.9	8.9	29.7
Rural to urban migration due to the need to employment	135	70.3	70.3	100.0
Total	192	100.0	100.0	

Source: Field Survey March, 2017

4.2.3. The Socio Economic Impact of Urban Sprawl in Debre Markos Town

4.2.3.1. The Feedback of the Respondent towards the Impact of Urban Sprawl

The respondents asked them self about the impacts urban sprawl specifically on the land resources and indirectly on their life. To end with this, the result had been displayed as follows. As table 4.15, indicated that180 (93.8%) of respondents were said yes urban sprawl has direct impact on land resource and indirectly on their life. Solely 12 (6.2%) of the respondent stated that urban sprawl (expansion) not affect the land resources rather pay the way for an employment opportunity to the society. When comparing these two opposing ideas, really urban sprawl has an impact specifically on land resource and generally on the environment.

Table4.14: View of Respondents about the Impacts of Urban Sprawl on their Livelihood

Number of respondent					
urban sprawl an impact on land	Frequency		Percent	Valid Percent	Cumulative Percent
	Yes	180	93.8	93.8	93.8
	No	12	6.2	6.2.0	100.0
	Total	192	100.0	100.0	

Source: Filed Survey March, 2017

4.2.3.2. Types of Impacts of Urban Sprawl

As it show in Table 4.15, most of the respondents 148(77.1%) of react that urban sprawl has an impact on loss of land, followed by loss of land and social fragmentation or segregation 27(14.1%), the remained respondents 17(8.9%) categorize urban sprawl under the impact of social welfare (like equip, eider). However, it is difficult to see exclusively these impacts one from the other. Hence, all of them are inter related or mutually inclusive.

Table4.15: Types of Impacts of Urban Sprawl

Number of respondents				
The type of impact due to urban sprawl	Frequency	Percent	Valid Percent	Cumulative Percent
loss of land and economic activity	148	77.1	77.1	77.1
loss of land, social fragmentation or exclusion	27	14.1	14.1	91.2
social welfare	17	8.9	8.9	100.0
Total	192	100.0	100.0	

Source: Field Survey March, 2017

4.2.4. The Impacts of Urban Sprawl on Farmers Sited in Peri-Urban Areas

4.2.4.1. Socio-cultural Interaction Problems

Urban sprawl towards to the periphery enforced the surrounding communities to leave their original settlement and live to new settlement position; this thing encounters the peripheral communities to different socio-cultural and economic problems. As it illustrated in table 4.15, some of the respondents (23%) of react that urban sprawl has an impact on social fragmentation or segregation. Thus, these household farmers are suffering from social relationship problems. In view of the fact that, they are far/separate from their relatives, Equip, Eider and Mahber as well as other social (cultural, traditional and religious practices) networks nevertheless, before the expansion of the city over there, these communities had very coupled relationship that is supported on socio-cultural institutions that require each and every member to support others at the time of disasters, and other conditions which are outside the capability of a household in certain time.

4.2.4.2. Agricultural Land Scarcity (Loss of Agricultural Land)

Agricultural lands in periphery of cities serve as a transition zones from natural and rural habitat to urban landscape. It provide vital ecosystem services such as food, clean air, soil, and water to the urban areas, and as a buffer zones to reduce negative effects of the urban systems on the natural environment (Dejene, 2011). The persistently increasing demands of peripheral land, brought by rapid urbanization have led to the ongoing squeezing out of farming as a means of livelihood to peripheral society. This strong pressure decreases available agricultural land in the area which has decreasing food security. for the phase of the previous few years, agricultural lands at periphery of Debre Markos town were widely converted to urban land uses such as residential, industrial, and commercial agricultural activities. Due to the suitability of its land, climatic condition and cheaper land price in relation to other city attracts large number of private investors. As a result, large numbers of the farmers living on the edge of the town were lost their farm land and became landless with appropriation of low cash payment.

4.2.4.2. Year and Number of Respondents Who Lost Their Land

As it showed, in table 4.16, from the total of 192 respondents 162 (84.4%) of the respondents claimed that their land was taken in the past 16 years (2001-2017), due to the cause of rapid urban expansion while, few remained 30 (15.6%) of the respondent declared that their land was not taken. thus the writer conclude that based on this evidence, all most all of the participant were the victim of this issue.

Table 4.16: year and Number of Respondent Lost Their Land

Year(2001-2017)					
Land lost due to the presence of urban sprawl	Number of respondents				
	Frequency		Percent	Valid Percent	Cumulative Percent
	No	30	15.6	15.6	15.6
	Yes	162	84.4	84.4	100.0
		Total	100.0	100.0	

Source: Filed Survey March, 2017

4.2.4.3. Sampled Respondents Land Size Lost in Hectare

The sampled respondent has been lost their land in different size. As indicated in table4.17, from the total sample respondent affected , 17(8.9%) of them lost land size 0.5-1 hectors whereas, the rest101(52.6%), 35(18.2%), 8(4.2%), and 1(0.5%) of participant lost land size between 1-1.5 hectare , 1-2 hector , 2-3 hectare and 3-4 hectare respectively. As indicated in table 4.11, most of the respondent lost land size between 0.5 and 1 hectare. However, the remained 30(15.6%) of them were not lost their land i.e. they are not the victim of this problem. Based on this evidence the majority the sampled respondent are suffered for this problem.

Table4.17: Land Lost in Hectare

Number of respondents				
land lost in hectors	Frequency	Percent	Valid Percent	Cumulative Percent
0 hectare lost	30	15.6	15.6	15.6
0.5 -1 hectare	17	8.9	8.9	24.5
1-1.5 hectare	101	52.6	52.6	77.1
1-2 hectare	35	18.2	18.2	95.2
2-3 hectare	8	4.2	4.2	99.5
3-4 hectare	1	0.5	0.5	100.0
Total	192	100.0	100.0	

Source: Filed Survey March, 2017

4.2.4.4. Types of Land the Participant They Lost

As seen from table 4.18, all most all of participant are lost different type of land use except only 30(15.6%) of them. As observed in analysis of the fact that on table4.20 majority of the respondent lost agricultural land 97(50.5%), the remainder participant 45(23.4%), 14(7.3%), and 8(4.2%) of lost residential land, open land and bush land (grazing land) respectively. From the total land lost agricultural lands lost ranked first which is most of the farmers depend their livelihood directly or indirectly take larger share. As a result, urban sprawl or expansion has an exact impact on the surrounding (peripheral) farming community's livelihoods income source.

Table4.18: Types of Land Lost.

Number of respondents				
types of land they lost	Frequency	Percent	Valid Percent	Cumulative Percent
not lost	30	15.6	15.6	15.6
agricultural land	97	50.5	50.5	66.1
residential land	45	23.4	23.4	89.5
open land	14	7.3	7.3	96.4
bush land (grazing land)	8	4.2	4.2	100.0
Total		192	100.0	100.0

Source: Filed Survey March, 2017

4.2.4.5. The Purpose of the Land Taken from Participants

The land taken from the sampled respondent in different time and year were used for diverse purpose and aims. However, each purpose had been explained in table 4.19, as followed. 109(56.8%) of the respondents land was taken for residential use to solve house shortage: due to the prescience high immigrant from rural area to the town as indicated above in the first part of this chapter. The remained respondent land was taken for industrials18 (9.4%), commercial agriculture 35(18.2%) like dairy farming and others. Solely 30(15.6%) of the total respondent had not lost their land related with this problem. In general the land that was taken for the purpose residence contributes a greater share which is the factor for decreasment of agricultural land and production.

Table 4.19: Purpose of Land Taken From Participants

Purposes of land that was taken from them	Frequency	Percent	Valid Percent
Residential	109	56.8	56.8
Industrials	18	9.4	9.4
Commercial agriculture	35	18.2	18.2
The respondent do not lost their land	30	15.6	15.6
Total	192	100.0	100.0

Source: Filed Survey March, 2017

4.2.4.6. Agricultural Production Decreasment with related to Land Lost

As indicated on the table 4.21, agricultural land lost takes greater shares; this is the main reason for the decrease of agricultural production. As table 4.20 shows that the net agricultural production lost for sampled respondents had been explained as follow. According to table 4.14, 9 (4.7%) of them decrease from 1-2 quintals, 75(39.1%), 78(40.6%) and 30(15.6%) of the respondent decrease their agricultural production from 2-3 quintals, 4-5 quintals and 0 quintal decrease respectively. Most of the respondent decreases their agricultural production between 4 to 5 quintals followed by from 2 to 3 quintals.

Table4.20: Agricultural Production Decrease in Quintal

Number of respondents				
Agricultural production decrease in quintals	Frequency	Percent	Valid Percent	Cumulative Percent
0 quintal decrease	30	15.6	15.6	15.6
1 -2 quintals	9	4.7	4.7	20.3
2-3 quintals	75	39.1	39.1	59.4
4-5 quintals	78	40.6	40.6	100.0
Total	192	100.0	100.0	

Source: Filed Survey March, 2017

4.2.4.7. The Current Occupation Engagement of Respondents

As it exhibited in table 4.21, the respondents are still on engaging on farming activities, which is 84.4% of the total and 15.6%, are not employed rather engaged on other economic activities. Thus, this entails still the life of the farmers is not transformed to another economic activity.

Table4.21: The Current Occupation of the Respondent

Number of respondents				
Occupation	Frequency	Percent	Valid Percent	Cumulative Percent
Farmer	162	84.4	84.4	84.4
daily labor	20	10.4	94.8	94.8
Merchant	10	5.2	5.2	100.0
Total	192	100.0	100.0	

4.2.5. The Role of Zone Administration and Town Municipality in Supporting Peri-urban Community

As the researcher obtained information from both the key informant interview and the respondents from this particular area the town municipality and zone administration gave compensation for most of victims by different means. 73.5% of the victims obtained compensation but 10.9% of the affected communities do not obtained compensation and the remained 15.6% of the respondent are not suffered for the problem. The type of compensation given for these victim communities has been listed as follow in table 4.22, 73(38.0%) of the affected participant obtained their payment in the form of money, 35(18.2%) in the form of alternative land and the remained obtained in the form of house pilot. However, most of the respondents do not satisfied by the compensation obtained. Because most of the respondents get their payment in the form cash that is finished with in short term need and not proportional compensation when compared to they lost. Still 10.9% of the victims asked their compensation but do not obtained. This idea indicates that how much the problem is severe specifically to the peripheral communities.

Table4.22: Type of Compensation for Victims (Filed Survey March, 2017)

		Number of respondents		
contribution of zone administration and	**Type of compensation**	Frequency	Percent	Valid Percent
	no any support get	21	10.9	10.9
	In monetary benefit	73	38.0	38.0
	Alternative land	35	18.2	18.2
	housing pilot	33	17.2	17.2
	not lost their land	30	15.6	15.6
	Total	192	100.0	100.0

CHAPTER FIVE

5. SUMMARY, DISCUSSION AND RECOMMENDATION

5.1. Summary

The study was conducted to identify the spatial extent, rate, pattern and the impact of urban sprawl on peripheral farming communities of Debre Markos town. As this study indicated that there is substantial land use and land cover change in the region of Debre Markos town. From this land use changes severity is observed from farm land. This comes from intensified land use alteration due to urban land use encroachment of rural lands particularly that of new residential development in to the periphery of the town. This caused a socioeconomic impact on the surrounding farming communities.

The first impact of urban sprawl is on farm land that is found on the periphery. Farm land is the main source of livelihood for the farmers. As a result, urban sprawl consumes this land, farm land size decrease from time to time. Consequently agricultural production decreased this affect adversely the livelihood of the farmers and their family. The second impact of urban sprawl is social fragmentation of the displaced communities like Eder, equip. Based on the result of the study, which was obtained from the analysis of changes of 2001 and 2017 land sat imageries; the extent of urban expansion over the farm land use in2001was not that to a great extent but greatly increased in 2017. As obtained from the finding built up (urban) land use was 3163.05 hectare (12.1%) and 5952.69 hectare (22.61%) in 2001 and 2017 respectively. however in the reverse farm land decreased from 11863.35 hectare to (45.06%) to 9811.53 hectare (37.3%) in 2001 and 2017 respectively. Generally the total expansion of the town within the sixths year duration 88.2% while, it's annually increasemente was 5.5% per year and characterized by more of leapfrog urban pattern to wards to the periphery.

5.2. Conclusion

Rapid population growth resulted uncontrolled Urban sprawl which is the common problem for developed and developing countries. But the severity of the problem is different at both countries. Ethiopia likely same as many of the developing countries has a problem with the unplanned urban expansion to its periphery and residential houses sprawl in many of its towns and cities. This growth extends not just inwards but outwards implying that satellite towns surrounding the city are being affected posing a threat to the limited available resources in the city resulting to high cost of living. On a local basis, the expansion of Debre Markos town to its rural outskirts, overtaking the wide, highly productive agricultural areas mostly used for cereal crops production and even this problem encounter the internal development of the town. Effort was prepared to capture as accurate as probably four land use-land cover-classes as they change through time. Remote sensing data were found to be useful in mapping and quantifying the historical land-use/land cover, the rate, pattern and the extent of urban expansion in diverse study periods. As a result success of information was obtained on land-use/land-cover changes with the aid of analysis of satellite images of 2001 and 2017 necessary to the study area. Based on this imagery and socio economic data analysis most of the land-uses either increased or decreased in size at different change rates in 2001 as compared to the reference year 2017.

As the satellite image and socio economic data analysis results illustrate that built up land use increased from the first study period to second study time. However, in the reverse farm land decreased from the first to the second study time. The impact of this LULC change is more significant on the socioeconomic circumstance and position of the study area. . It is important bring into being to measure urban sprawl and its impact on peri-urban ecosystem and try to find sound solution to minimize the stress or even avoid it. Urban sprawl is initially detected by gauging urban growth in many ways. In general these methods of data analysis are not giving accurate information such as the direction where urban sprawl occurs and the level of services needed on the new developmental sites. But remotely sensed data are easily integrated into Geographic Information system (GIS) gives accurate information regarding the spatial extent, rate, pattern and its

socioeconomic impact of rapid urban expansion. For this reason, some researchers used this technology in order to study about urban sprawl and its impact; like Abebe (2012), Atalel (2014) Zewdu (2011), Adamu (2010), Dejene (2016) and Mbuta (2013) and all of them obtained fine result related to the above issue with the help of GIS and RS techniques. Therefore, the researcher is intended to utilized geospatial technology to quantify the extent of current uncontrolled urban sprawl to periphery of the study area. This gives an insight to the urban planners and engineers as an essential means of rapidly assessing the dynamic of land use /land cover change of Debre Markos town.

5.3. Recommendations

Due to the persistent increase in urban sprawl in both extent and the rate in the study area, and its socioeconomic impact to the surrounding farming communities, as a result the following recommendation is suggested:

- In general the study area characterized by more of leapfrog urban sprawl development; the reason of leapfrog development because of around this area there is large tracts of land are available at moderate cost. Therefore the town administration should manage the land price to periphery to minimize this rapid out ward development of the town.
- The federal government must revised the rule and regulation related to the urban land use management system and encourage the vertical urban expansion and restricted the horizontal urban expansion especially to the periphery farm land that is the source of the livelihood to the communities
- Urban planning authorities should have to depend on a GIS data base and information system to adjust their urban development in a sustainable way such that they will manage the supply of public services and infrastructures that will be needed as a result of future urban expansion.

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APPENDIX

JIMMA UNIVERSITY

COLLEGE OF SOCIAL SCIENCE AND HUMANITIES

DEPARTMENT OF GEOGRAPHY AND ENVIRONMENTAL STUDIES

Questionnaire

Dear respondent:-The main aim of this questionnaire is to gather data as input for the study titled as GIS and RS based analysis Urban sprawl and its impact on surrounding area: the case of Debre Markos town, East Gojjam zone, Amhara Region, Ethiopia." whose sole purpose is to qualify the requirement for awarding in Partial Fulfillment of the Requirements for the Degree of Master of science in Geographic information system and Remote Sensing at Jimma University, College of Social Sciences and Humanities, Department of Geography and Environmental Studies. Therefore, thanking in advance for your co-operation, I assure you that each pieces of information collected via this tool are to be very much confidential not apart from for the purpose pointed out here above. Please note with the intention of:

- There is no need to Wright your name
- Follow the instruction of each question
- Return the questionnaire to the researcher, as soon as you complete filling it.

Part one Back ground of Respondents

1, Zone: ———

2, Keble:———

3, Age: 25-30 ☐ 31-35 ☐ 36-40 ☐ 41-45 ☐ >46 ☐

4, sex: male ☐ female ☐

5, marital status: Single ☐ Married ☐ Divorced ☐ Un Married ☐

6, Occupation: farmer ☐ merchant ☐ Daily labor ☐ Government employ ☐

7, level of education: Illiterate ☐ 1-4(primary school ☐ 5-8(secondary ☐ school)

9-10(high school) ☐ 11-12(preparatory) ☐ >12 complete and above ☐

8, Number of family size: 1-2 ☐ 3-5 ☐ 6-7 ☐ >8 ☐

Part two Questionnaire prepared to achieve the stated objectives

1. Which one is the major cause of urban sprawl?

A. Migration C. land reclassification

B. Population growth D. industrial development

2. Which is one more affected due to the case of urban sprawl?

A. natural environment B. economic activates C. social wafer D. all

3. Is urban sprawl an impact on land use change?

A. Yes B. no

4. If you say yes the above question3, what are the major impacts?

_____

5. Do have lost your plot of land due to the presence of urban sprawl?

A. yes B. no

6. If say question 5, what types of land do you have lost by case of urban sprawl?

A. agricultural land B. open land C. residential land D. bush land

7. If you say agricultural land, how many hectares due have lost?

_____

8. Is urban sprawl affects your agricultural production?

A, yes b, no

9. If you say yes question 8, how many quintals due lost?

_____

10. For what purposes did the plot of land was taken?

A. Commercial agriculture B. Residential C. Industrials

11. What role is zone administration contributed to solve the above problems from questions No1-10?

_____

12. What type of service do you get from the municipality/ town administration?

A. Land provision B. resettlement assistance

C. providing job opportunity

13. What role could the government and nongovernmental institutions play in improving the life of the local people affected by urban sprawl? (Capacity building, social organization and strengthening the available institutions)

A. Things need to be introduced, revised avoided

B. provide immediate need

C. a need for future intervention

14. Is the rate urban sprawl is faster in currently than the past in Debre Markos town?

A. yes B. no

15. If you say the above question 3, yes, what are the reasons?

_____

Part three Guideline for Key Informant Interview

Name of Respondent————————

Zone ——————— Kebeles ———

Occupation ————————————

Position ————————————

Level of Education————————————

Year of service in this organization————————

Interview for the stated Objectives

1, what looks like the trend of, the physical growth of the town? ————————

————————————————————————————————————

2. What is your feeling about the land use land cover change occurred related to the town sprawl?————————————————————

3. What social, economic, and cultural changes did you face as a result of urban sprawl?

————————————————————————————————————

4. Will you explain the general problem of urban sprawl?————————————————

6. What role can the governmental institutions play in improving the life of the surrounding community affected by urban sprawl? ————————————

7. Is the city sprawl rate going with planning?————————————————

8. If you say yes question 6, how they plan? ————————————————

9. For what purpose your farmland had been converted due to urban sprawl? ————————

10. What procedures that municipality used to acquire land for urban sprawl? ————————————

Part four Filed observation

In order to demonstrate the physical out ward sprawl of the town and its direction the researcher will conduct field observation with key informants with the following questions

1. The trend of, the physical growth of the town.

2. To identify the growth direction of the town, and highly affected communities

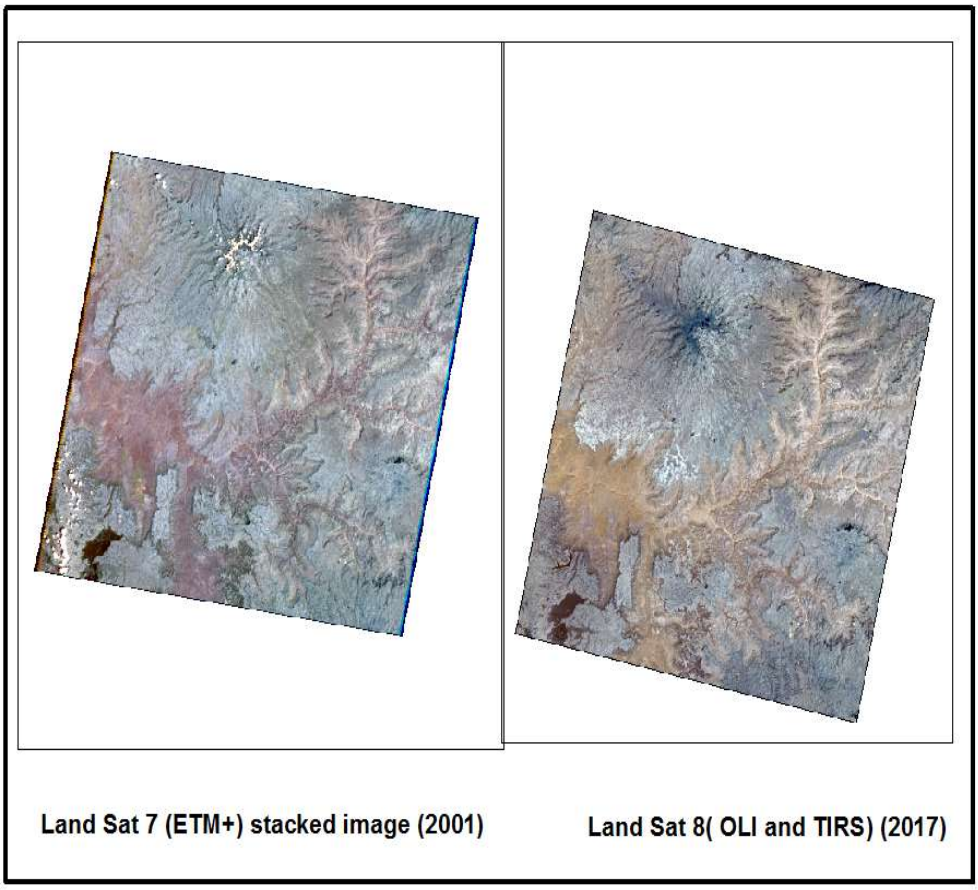
3. to identifying the pattern of urban sprawl

4. To take GPS training points to cross check with the satellite image classification.

Meta Data of Land sat 8(OLI _ TRIS) and 7(ETM+) Imagery

	land sat7(ETM+)	Land sat8(OLI_TIRS)
Data set attribute	Value	Value
Land sat scene Identifier	LC16900532017001LGN00	LE71690532001045SGS01
WRS Path	169	169
WRS Row	53	53
Start Time	2017:001:07:46:07.3439170	2001:045:07:36:22.7375743
Stop Time	2017:001:07:46:39.1139140	2001:045:07:36:49.7464492
Cloud cover	0	0
Image quality	9	9
Datum	WGS_1984	WGS_1984
UTM Zone	UTM_Zone_37N	UTM_Zone_37N

Source: USGS



Source: USGS

fig 1:Linear development

fig2: Urban sprawl in Debre Markos Related different Investment

Fig3: Leapfrog development of Debre Markos town

Source: filed survey March, 2017

Figure4: Filed observation and Key informant interview of the elders by the researcher

Source: filed survey March, 2017

Table: GPS points

Id	Easting	Northing	Land use class	Easting	northing	Land class
1	360441.5	1137884.29	farm land	363007.1	1138984.33	vegetation
2	361431.5	1137089.18	farm land	363427.1	1139579.55	vegetation
3	360922.4	1138649.03	farm land	358645.5	1141477.1	vegetation
4	360329.9	1138434.99	farm land	359431.7	1139644.31	vegetation
5	360229.5	1137710.27	farm land	359792.9	1140746.52	vegetation
6	357900.8	1145205.5	farm	359541.6	1143248.53	vegetation

			land			
7	360294.6	1138105.69	farm land	362741.4	1143271.26	vegetation
8	364404.5	1137705.54	farm land	361475.7	1144569.35	vegetation
9	360279.3	1137801.75	farm land	364208.4	1140017.19	vegetation
10	360859.6	1138699.47	farm land	358622.2	1141546.9	vegetation
11	359757.1	1146425.29	farm land	361458.5	1144562.18	vegetation
12	363518.3	1143919.15	farm land	362736.6	1143289.63	vegetation
13	363833.6	1145311.23	farm land	360237.3	1142048.96	vegetation
14	360145.8	1137760.6	farm land	360400.8	1142342.63	vegetation
15	359249.1	1137559.35	farm land	360530	1142272.14	vegetation
16	360099.5	1137670.62	farm land	360055.9	1143122.32	vegetation
17	364459.2	11377470.65	farm land	359725.5	114289.68	vegetation
18	360358.2	1138290.23	farm	360078.4	1143123.02	vegetation

			land			
				359493.9	1143375.14	vegetation
				360111.9	1143861.09	vegetation

Id	Easting	Northing	Land use class	Easting	Northing	Land class
1	360296.014	1144512.27	built up area	358156.9	1145232.14	open land
2	360248.97	1144439.16	built up area	358284.5	1145069.17	open land
3	360358.04	1144632.44	built up area	359178.16	1144252.02	open land
4	360381.42	1144439.15	built up area	359101.2	1144312.62	open land
5	360667.67	1144622.94	built up area	359222.31	1144182.74	open land
6	3606617.26	1144620.15	built up area	359292.25	1144334.35	open land
7	360551.54	1144482.95	built up area	359302.71	1144302.5	open land
8	36o391.87	1144444.55	built up area	359813.91	1146604.57	open land
9	360473.6	1144378.2	built up area	359531	1145952.26	open land
10	360627.8	1144370.56	built up area	358840.62	1145449.94	open land

11	360348.81	1144626.1	built up area	357426.07	1144804.61	open land
12	360499.62	1144653.12	built up area	357728.57	1143110.38	open land
13	360653.81	1144603.83	built up area	357789.78	1143108.21	open land
14	360714.64	1144550.98	built up area	357240.11	1142997.12	open land
15	360664.78	1143805.17	built up area	358116.19	1140645.54	open land
16	360317.55	1143698.49	built up area	359245.6	1137718.55	open land
17	360241.4	1143706.5	built up area	360413.27	1137753.78	open land
18	360203.03	1143729.04	built up area	360733.38	1137007.57	open land
19	360256.11	1143765.57	built up area	362260.67	1138438.37	open land
20	360174.89	1145232.14	built up area	362898.96	1136879.74	open land

Source: Filed survey March, 2017

Thank You!